PolarBear

Conflicts with Humans

Northwest Territories Renewable Resources

Contract Report Number 3

POLAR BEAR - HUMAN CONFLICTS

February 1988

Susan Fleck
Box 1078, Yellowknife, NWT
X1A 2N8

Steve Herrero
Faculty of Environmental Design
University of Calgary
Calgary, Alta.
T2N 1N4

for

PARKS CANADA
Prairie Region
(Contract 502/85/23)

and

DEPARTMENT OF RENEWABLE RESOURCES
Government of the NWT
Yellowknife, NWT

1988

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92-01458/

ABSTRACT

This study asks why polar bear - human conflicts occur and how such conflicts can be reduced. The recommendations apply to anyone attempting to protect people living, travelling, or working in the Arctic from polar bears and to reduce the number of polar bears killed because of conflicts with humans. Over a 20 year period in the Northwest Territories (NWT) and Manitoba, humans were injured or killed during only 19 interactions with polar bears. Over the same time period, at least 230 polar bears were killed. A typical polar bear - human interaction in the NWT occurred between midnight and 6 am when people are asleep or within a shelter. More conflicts without human injury have occurred during the ice-free months at Inuit hunting camps when bears are attracted by animal carcasses or camp odours. However, most interactions that resulted in human injury occurred at industrial exploration camps during the winter season. In Manitoba, a typical polar bear - human interaction occurred in Churchill when there is no ice on Hudson Bay. The rate of interaction increased as polar bear and human density increased. The results support the hypothesis that predaceous attacks by polar bears on humans have occurred. Overall, attacks by male polar bears and one subadult female polar bear appeared to be predatory. In contrast, productive female polar bears appeared to attack humans to protect their cubs. The potential for polar bear - human conflicts in northern parks is compared to black and/or grizzly bear - human conflicts in Canadian and American national parks. Recommendations to avoid conflicts focus on five areas -- alertness, avoidance, attractants, detection, and deterrents. We recommend that responses of humans vary in relation to the type of behaviour displayed by a polar bear.

EXECUTIVE SUMMARY

Conflicts between polar bears and humans occur every year in the Arctic. Often the result is a dead polar bear; more rarely, a dead or injured human. This concerns management agencies such as Parks Canada and the Department of Renewable Resources, Government of the Northwest Territories because of their dual responsibilities to protect people that live, travel, or work in the Arctic and to maintain viable polar bear populations. These agencies have been developing bear detection and deterrent techniques and implementing programs to minimize bear - human conflicts without having analyzed why such conflicts occur. This study examines that question and uses the answers to recommend techniques to avoid and minimize polar bear - human conflicts.

Agencies known to be responsible for polar bear management were contacted to obtain records of aggressive polar bear - human interactions. Biologists and Inuit hunters were interviewed to augment the review of available literature on ecology, distribution, and behaviour of polar bears. Data on rate of grizzly and/or black bear - human interactions in Canadian and American national parks were collected.

Records of 20 injurious and 353 non-injurious aggressive interactions between polar bears and humans that occurred primarily in the Northwest Territories (NWT) and Manitoba

between 1965 and 1985 were collected. At least 230 polar bears were killed. Fifteen men and one woman were injured and 6 men were killed. Far fewer people have been injured or killed by polar bears than by black and grizzly bears. Even the rate of human injury and death from black and grizzly bear attacks is low when compared to human deaths by lightning or bites or stings of venomous animals.

No humans have been injured or killed by polar bears in Canadian National Parks, National Historic Parks, or National Historic Sites, however, several non-injurious aggressive interactions have occurred. The potential for a visitor to Auyuittuq National Park to have such an interaction with a polar bear is higher than for any visitor to a Canadian or American national park containing black and grizzly bears. The potential for such interactions at the Churchill National Historic Park and Sites is probably even higher, however, all bears are deterred from these sites by Parks Canada staff before visitors are allowed access.

Maternal denning areas, summer retreats, fall staging sites, and winter concentration areas within existing or proposed Canadian national parks are identified. Polar bears predictably use these habitats every year. Managers of parks and polar bears can use this knowledge to develop guidelines to reduce risks for park visitors.

A typical polar bear - human interaction in the Northwest Territories involved a subadult male polar bear investigating the carcasses at an Inuit hunting campsite usually between midnight and 6 am when people were asleep or within a shelter. Over half of the non-injurious interactions occurred during the four ice-free months (August - November). However, proportionately more interactions resulting in human injury or death involved an adult polar bear and occurred at an exploration camp during the winter season.

In Manitoba, two-thirds of all aggressive polar bear - human interactions occurred at Churchill. Between December and August, polar bears remain on Hudson Bay sea ice far away from Manitoba. As polar bears come ashore when the ice melts, the rate of interactions increased as polar bear and human concentrations increased. Again subadult male polar bears were involved in more interactions than any other sex and age class.

During most non-injurious interactions, attractants (that is a potential source of food) were present. However, in over half of the injurious interactions, no attractants were present suggesting that the victim may have been the attractant.

We were able to distinguish several types of attacks by polar bears. Male polar bears typically wounded their victims in the same way as they would kill a seal, that is bites to the head and neck. At least five of the ten male bears consumed part of their victim. In several cases, the bear appeared to have stalked its victim. Nine of ten bears had to be killed to end the interaction. We feel that these attacks were predatory. A person involved in an injurious interaction should fight back if they suspect that the attack is predaceous.

In contrast, only one subadult female and no adult females behaved in a predaceous manner. Only females accompanied by cubs injured humans. The victims were not bitten in the head or neck area and none were killed. In each situation, the victim and female polar bear appeared to suddenly encounter one another without having previously been aware of each other. The female polar bears appeared to perceive humans as threats to their cubs and would attack. Three of the four females with cubs ended their attacks on their own initiative. We do not believe that these attacks were predatory. A person involved in this type of an attack should play dead and protect their vital areas during an attack.

Provoked attacks by polar bears appear to be rare. Most polar bears retreated when injured during an interaction.

In 89 percent of aggressive polar bear - human interactions deterrents were deployed. Many types of deterrents were tried. Success was variable. Because almost all of the deterrents used in the interactions we collected are different from the deterrents tested by researchers, results are not comparable.

Recommendations to reduce conflicts focus on five areas -- alertness, avoidance, attractants, detection, and deterrents. People living, working, or travelling in the Arctic should always be alert for the potential appearance of a polar bear. Polar bears can be avoided by learning about polar bear ecology and habitat use. Keeping potential food sources well away from camp sleeping and activity quarters can help to reduce potential interactions. Different types of detection devices are available to give early warning of an approaching polar bear. This allows time to assess the situation and to deploy deterrents. Management agencies can be contacted to determine which deterrents are recommended. Everyone should know how to use the deterrents that are available in a camp.

However, as a last resort, we believe that firearms are a necessity. We emphasize that firearms are only as effective as the person's ability to use them. If a person has no expertise with firearms then a guide that is experienced with firearms and polar bears should be sought. If that option is not available, a person should reconsider their itinerary. Since firearms may not be carried within national parks, options available to park managers to reduce polar bear - human interactions include area closures, detection and deterrent programs to keep polar bears and visitors separate, mandatory use of bear-proof camp enclosures, and public education programs.

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ACKNOWLEDGEMENTS

We would like to thank Parks Canada, the Northern Oil and Gas Program (NOGAP) of Indian and Northern Affairs Canada, and the Department of Renewable Resources (GNWT) for financial and logistical support to conduct this study. The records of interactions with polar bears collected by K. Poole, J. Lee and G. Stenhouse provided an invaluable start to the project. The assistance of B. Herbert, J. Hines, and L. Turney in setting up the data base on the computer was greatly appreciated. B. Dean and F. Shults kindly extracted polar bear references from the bear bibliography maintained at the University of Alaska. I. Stirling and S. Kearney gave us unlimited access to their files to search for records of interactions. A. Gunn, G. Williams, P. Voudrach, I. Ross and P. Watts interviewed Inuit hunters and collected stories of interactions for us. J. Troje expertly drafted the figures and J. Pin assisted with copy editing. Lastly, we would like to thank all those people who contributed their time so freely when asked to discuss polar bears and people. The constructive comments of P. Gray, J. Lee, M. Taylor, R. Leonard, and G. Stenhouse improved the manuscript.

1. INTRODUCTION

Conflicts between polar bears and humans have occurred throughout the circumpolar range of polar bears. This study asks why polar bear - human conflicts occur and how such conflicts can be minimized.

Parks Canada and the Department of Renewable Resources, Government of the Northwest Territories (GNWT) defined this question to improve management techniques that will reduce conflicts and conserve both polar bears and people. The underlying premise was that the obligatory carnivorous habits of polar bears influenced them to behave differently towards humans than their opportunistic omnivorous cousins -- black and grizzly bears.

Parks Canada has an obligation to inform and advise visitors to national parks about polar bears and to manage visitors and polar bears so as to prevent human injury whenever possible. The Department of Renewable Resources, GNWT also has a strong interest in educating people about black, grizzly and polar bears to increase human safety in wilderness areas.

Parks Canada and the Department of Renewable Resources, GNWT both have an obligation to conserve polar bears for a number of reasons. First, Canada is part of an international agreement that "restricts the taking of polar bears, and directs the signatory nations (United States of America (US), Union of Soviet Socialist Republics (USSR), Canada, Norway, and Denmark) to conduct research to identify the status of populations of polar bears and to protect the areas that are critical to the survival and reproduction of polar bears." (DeMaster and Stirling 1981).

Second, the mandate of both agencies includes maintaining healthy populations of all wildlife species within their jurisdictions.

Third, the annual harvest of polar bears in the Northwest Territories is restricted through the allocation of a quota to each community. In most areas quotas are thought to be close to or may even be over the maximum harvest that can be sustained by that subpopulation of polar bears. For example, in the two Baffin Island communities of Clyde River and Broughton Island, Northwest Territories, Inuit hunters have voluntarily reduced their harvest since 1985/86 in response to suspected overharvest (Lloyd 1986). Polar bears killed in defence of life and property are not usually included in a community's quota. The addition of bears killed as a result of polar bear - human interactions to bears killed under the community quota could cause a decline in subpopulation size in zones where quotas represent the maximum sustainable harvest.

Fourth, the harvest of polar bears in Canada represents a significant source of income to residents of all coastal Northwest Territories communities (Smith 1979). The pelt of a polar bear killed as a result of a polar bear - human interaction cannot be sold unless it is included within a community's quota. If it were included in the quota, the value of such a pelt is often low because many problem bears are subadults and are killed during summer; meaning that hides are small and fur is not prime.

Every year black and/or grizzly bears injure humans and cause property damage. Some of these bears are killed each year because of the problems they create for humans. Many of the problems created by bears are due to attraction of bears to garbage and subsequent interactions with people. A few injurious interactions occur because bears have viewed people as prey (Herrero 1985).

In northern Canada, the system of national parks and historic sites is being expanded. Polar bears occur in several existing and prospective areas and are known to be dangerous to humans (Jonkel 1970). In Churchill, Manitoba many of the problems have related to garbage disposal and also because polar bears concentrate along the Manitoba coastline each fall waiting for ice to form on Hudson Bay.

Parks Canada has a bear detection and deterrent program in place at its National Historic Park and Sites that are located in the Churchill area. Through this program an attempt is made to deter all polar bears from an area before visitors enter. One employee acts as a bear monitor and carries a firearm. However, the National Parks Act forbids tourists to carry firearms within a national park. This contrasts with the general northern tradition of always travelling with a firearm when the potential for a polar bear - human interaction exists.

The four objectives of this contract as defined by Parks Canada and the Department of Renewable Resources are:

1. Review the available data on polar bear - human conflict;
2. Develop a descriptive model of polar bear - human conflict;
3. Review the potential for polar bear - human conflict on park lands; and
4. Make recommendations on methods to minimize polar bear - human conflict with emphasis on protecting both bears and people.

2. METHODS

Within Canada, we collected records of polar bear - human interactions from the following sources: (1) unpublished records of polar bear - human interactions maintained by the Wildlife Management Division, Department of Renewable Resources, Government of the NWT, Yellowknife, NWT; (2) annual reports of the Polar Bear Control Program, Department of Natural Resources, Government of Manitoba, Churchill, Manitoba; (3) interviews with polar bear biologists, wildlife officers, and Inuit hunters; (4) unpublished records maintained by Parks Canada for Auyuittuq National Park, Pangnirtung, NWT and for three Churchill, Manitoba National Historic Park and Sites (Prince of Wales, Cape Merry and Sloop's Cove); (5) goose camps along the coast of Hudson Bay; and (6) reports in published literature. We used records, jointly maintained by the Department of Renewable Resources and Canadian Wildlife Service, Department of the Environment, Government of Canada, Edmonton, Alta., on dead or captured polar bears to determine age and history of problem bears, polar bears killed on quota, and captured bears.

Outside of Canada, we contacted all other agencies known to us to be responsible for polar bear management to determine whether records of aggressive polar bear - human interactions are maintained and if we could access these.

Data were requested from ten Canadian and five American National Parks for the following statistics on a per year basis, 1980-1985: (1) total number of visitors; (2) total number of backcountry user nights; (3) total number of injuries and/or deaths caused by black, grizzly and polar bears (injurious aggressive interactions) in frontcountry and backcountry areas; and (4) total number of frontcountry and backcountry situations where bears were perceived to have acted aggressively towards humans and no humans were injured (non-injurious aggressive interactions).

Total number of visitors was defined as the total number of visitors that passed through park gates or were recorded by park officials each year. Backcountry overnight use was determined by multiplying the number of people hiking in backcountry areas by the number of nights stayed. No estimates for day use of backcountry areas were received.

The numerator and denominator in the following formula were modified accordingly to calculate the different rates of injurious and non-injurious aggressive interactions for various parks between the six year period 1980 to 1985:

$$\frac{(\text{sum of injurious aggressive interactions by a bear species})/6}{(\text{sum of visitors per year})/6}.$$

We interviewed 14 polar bear biologists, 1 wildlife officer, and 11 Inuit polar bear hunters to augment our review of available literature on ecology, distribution and behaviour of polar bears. Information for existing or proposed National Parks, and Historic Parks and Sites was obtained from Parks Canada.

We developed nine research hypotheses from the study objectives. These hypotheses determined the data requirements. We designed a two part questionnaire that contained 100 data fields with predefined answer codes. For example, "bear sex" would be a data field and the predefined answer code would be "M" (male) or "F" (female). This allowed us to translate information from interactions into a database. We entered verified records of polar bear - human interactions onto a Hewlett Packard Vectra computer and used dBase III Plus (Ashton-Tate 1986) for storage and analysis.

Analysis consisted primarily of quantifying the various responses to each data field. Chi square was used to test for goodness of fit.

3. RESULTS AND DISCUSSION

3.1 Rates of bear - human interactions in Canadian and American national parks

The first research hypothesis was that in northern parks where polar bears occur, there is a higher rate of aggressive interactions with visitors than in southern parks containing black or grizzly bears.

To test this hypothesis we analyzed injurious and non-injurious aggressive interactions separately to determine whether patterns for bear species differed among parks. For the same reason we contrasted the rates of interactions for all park visitors with those for backcountry users.

Total number of visitors to most national parks has either increased or remained the same, however, backcountry overnight use declined 20 to 40 percent between 1980 and 1985 in all five American national parks and Kluane National Park (Fig. 1). Overnight use increased several fold in four Canadian parks (Yoho, Glacier/Revelstoke, Riding Mountain, and Nahanni) while it remained the same or decreased slightly in the remaining five Canadian parks. In comparison to all other national parks, Auyuittuq has an insignificant volume of visitors but total overnight use

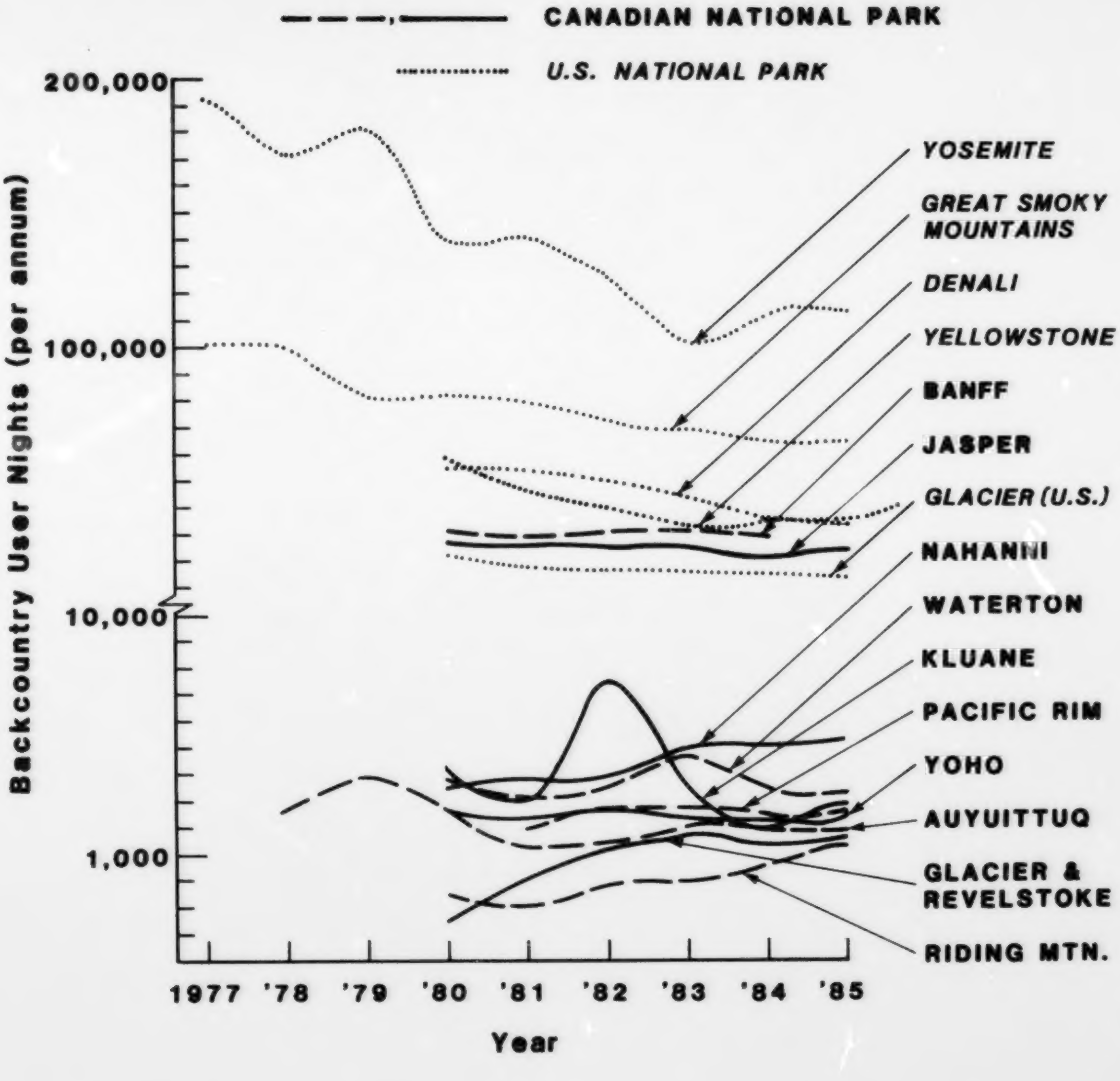

Figure 1. Annual backcountry use in Canadian and American national parks.

rivals that of several other Canadian parks because of the length of time that visitors stay at Auyuittuq.

Two biases are evident in the results. First, the annual rates of injurious and non-injurious aggressive interactions are slightly underestimated because the numbers of total visitors and backcountry user nights were not adjusted to reflect the time period when grizzly and black bears are active (April to October inclusive). Second, the rates of injurious and non-injurious aggressive interactions in backcountry areas are overestimated because we had no data on day use of backcountry areas.

We cannot overemphasize that the rate of injurious interaction of a park visitor with any species of bear is very low in all national parks (Tables 1 and 2). The junior author states that grizzly bears kill "far fewer people in the United States (two deaths in 1976; none in 1977) than lightning (81 deaths in 1976; 116 in 1977) or the bites or stings of venomous animals (53 deaths in 1976; 55 in 1977)." (Herrero 1985). Our detailed search found records of only four people being killed by polar bears during the last 15 years in North America.

Regarding black and grizzly bears, more injuries occurred in American (n=75) than Canadian (n=9) national parks

Table 1. Rates of injurious interactions with black, grizzly, and polar bears in relation to total number of people visiting Canadian and American national parks between 1980 and 1985.

Park	Mean number visitors per year	Mean number of visitors per injury from Black bears	Grizzly bears	Unknown bears	Polar bears	All bears
Revelstoke/ Glacier	3,899,154	-	-	*	*	-
Riding Mtn.	864,311	-	*	*	*	-
Pacific Rim	677,247	-	-	*	*	-
Nahanni	692	-	-	*	*	-
Yoho	1,137,956	-	6,693,859	*	*	6,693,859
Banff	3,360,000	-	4,048,193	*	*	4,048,193
Jasper	1,877,700	2,802,537	*	*	*	2,802,537
Great Smoky Mountains	8,530,000	2,561,561	*	*	*	2,561,561
Yellow-stone	2,314,930	7,014,939	1,543,287	13,617,235	*	1,157,465
Waterton	673,883	2,042,070	2,042,070	*	*	1,021,035
Glacier-USA	1,526,724	-	848,180	8,980,729	*	763,362
Yosemite +	2,265,722	629,367	*	*	*	629,367
Denali	328,645	-	328,645	*	*	328,645
Kluane	54,009	-	317,700	*	*	317,700
Auyuittuq	241	*	*	*	-	-

- no injuries or deaths by this species between 1980 and 1985 inclusive

* species does not occur in park

+ number adjusted to represent number of visitors in the park between April and November when the bears are active

Table 2. Rates of injurious interactions with black, grizzly, and polar bears in backcountry areas of Canadian and American national parks between 1980 and 1985.

Park	Mean number backcountry user nights per year	Mean number of backcountry user nights per injury from				
		Black bears	Grizzly bears	Unknown bears	Polar bears	All bears
Pacific Rim	?	-	*	*	*	-
Banff	30,230	-	-	*	*	-
Jasper	23,969	-	-	*	*	-
Mt. Revelstoke/ Glacier	1,351	-	-	*	*	-
Riding Mtn.	815	-	*	*	*	-
Great Smoky Mountains	72,016	N	*	*	*	N
Denali	40,221	-	118,297	*	*	118,297
Yosemite	118,180	59,090	*	*	*	59,090
Yellowstone	45,090	-	33,902	265,235	*	30,060
Kluane	3,978	-	23,400	*	*	23,400
Yoho	2,703	-	15,900	*	*	15,900
Glacier-USA	16,784	-	9,873	98,729	*	9,324
Waterton	3,794	11,383	11,383	*	*	5,691
Auyuittuq	2,149	*	*	*	-	-

? no estimates of numbers of backcountry user nights
- no injuries by this species between 1980 and 1985 inclusive
* species does not occur in park
N injuries have occurred but locations of interactions not available

(1980-1985) although visitor volume was only 25 percent higher. No park visitors were injured by polar bears.

Non-injurious aggressive interactions between park visitors and bears were reported for all national parks except Pacific Rim (Tables 3 and 4). In these interactions, bears were perceived to have acted aggressively by park visitors. The number of non-injurious aggressive interactions that occurred at Yosemite, Banff and Great Smoky Mountains National Park was not recorded, however, at Yosemite and at Great Smoky Mountains they have been in excess of 50 every year (Herrero 1985:96; B. Cook, pers. comm.). None have been reported for the three National Historic Parks and Sites near Churchill, Manitoba because staff maintain a watch for polar bears at all times to ensure that bears keep their distance from any visitors (Leonard 1985).

However, between 1981 and 1984, 142 polar bears were either deterred from or visually monitored at the three National Historic Park and Sites at Churchill, Manitoba in an effort to prevent an aggressive encounter with a visitor (R. Leonard, pers. comm.). The total area covered by these three sites is only 110 acres (44.5 ha). These sites are only open to day use and less than 5,000 people visit these sites annually (S. Billenduke, pers. comm.).

Table 3. Rates of non-injurious interactions with black, grizzly, and polar bears in relation to total number of people visiting Canadian and American national parks between 1980 and 1985.

Park	Mean number visitors per year	Mean number of visitors per aggressive but non-injurious interaction with				
		Black bears	Grizzly bears	Unknown bears	Polar bears	All bears
Pacific Rim	677,247	-	*	*	*	-
Banff	3,360,000	N	N	*	*	N
Yosemite +	2,265,722	N	*	*	*	N
Great Smoky Mountains	8,530,000	N	*	*	*	N
Mt. Revelstoke/ Glacier	3,899,154	-	22,936,200	*	*	22,936,200
Riding Mtn.	864,311	2,619,124	*	*	*	2,619,124
Yoho	1,137,956	1,137,956	1,371,031	*	*	621,834
Jasper	1,877,700	751,080	331,164	*	*	229,829
Glacier-USA	1,526,724	1,174,403	227,586	1,017,816	*	183,943
Yellowstone	2,314,930	925,972	220,470	1,543,287	*	159,650
Waterton	673,883	192,538	130,345	2,042,070	*	74,876
Denali	328,645	196,793	13,146	164,333	*	11,463
Kluane	54,009	65,071	27,005	*	*	10,084
Nahanni	692	-	4,071	*	*	4,071
Auyuittuq	241	*	*	*	730	730

- no aggressive, non-injurious interactions with this species between 1980 and 1985 inclusive

* species does not occur in park

N aggressive interactions occurred but data are not available

+ number adjusted to represent number of visitors in park between April and November when bears are active

Table 4. Rates of non-injurious aggressive interactions with black, grizzly and polar bears in backcountry areas of Canadian and American national parks between 1980 and 1985.

Park	Mean number backcountry user nights per year	Mean number of backcountry user nights per aggressive but non-injurious interaction with				
		Black bears	Grizzly bears	Unknown bears	Polar bears	All bears
Pacific Rim	?	-	*	*	*	-
Riding Mtn.	815	-	*	*	*	-
Yosemite	118,180	N	*	*	*	N
Great Smoky Mountains	72,016	N	*	*	*	N
Banff	30,230	N	N	*	*	N
Glacier-USA	16,784	N	N	*	*	N
Nahanni	4,703	-	27,665	*	*	27,665
Jasper	23,969	13,074	-	*	*	13,074
Mt. Revelstoke/ Glacier	1,351	-	8,108	*	*	8,108
Yellowstone	45,090	18,461	8,123	50,768	*	5,077
Yoho	2,703	8,110	8,110	*	*	4,055
Denali	40,221	48,459	2,260	30,241	*	2,011
Kluane	3,978	4,793	1,989	*	*	1,406
Waterton	3,794	1,751	1,265	11,383	*	690
Auyuittuq	2,149	*	*	*	6,512	6,512

? no estimate of number of backcountry user nights

- no aggressive, non-injurious interactions with this species between 1980 and 1985 inclusive

* species does not occur in park

N aggressive non-injurious interactions have occurred but locations of interactions not available

Although the number of visitors to Auyuittuq is orders of magnitude less than for all other parks except Nahanni, two non-injurious aggressive interactions with polar bears were recorded between 1980 and 1985, suggesting that the potential of having such an encounter with a polar bear is much higher per visitor than in any park containing black or grizzly bears (Table 3). The implication to the park manager is to expect an encounter every couple of years and to recognize that the potential for an injurious aggressive interaction does exist.

In the two American National Parks, Glacier and Denali, the rate of non-injurious aggressive interactions in the whole park declined between 1980 and 1985. In Denali, the decline (Table 5) is due primarily to increased success of techniques used to separate visitors and bears and/or better management of people, food and garbage (Dalle-molle and Van Horn, in prep.) (Table 5).

In contrast, the rate has increased in Kluane National Park, suggesting a potential problem in the future (Table 5). The same patterns were evident for rate of non-injurious aggressive interactions in backcountry areas (Table 5).

Orders of magnitude difference in rates among parks are no longer evident when comparing the number of non-injurious

Table 5. Rates of non-injurious aggressive interactions with black and grizzly bears in relation to (a) total number of visitors; and (b) total number of back-country user nights in Denali and Kluane National Parks between 1980 and 1985.

Year	Denali		Kluane	
	(a)	(b)	(a)	(b)
1980	6,556	2,103	*	*
1981	9,869	2,513	*	*
1982	8,470	1,513	*	*
1983	10,851	1,325	25,353	1,871
1984	15,777	2,897	10,004	348
1985	24,252	2,386	7,260	349

* no aggressive interactions occurred

aggressive interactions that occurred in backcountry areas (Table 4). However, if the unit of comparison was per backcountry visitor, the rate for Auyuittuq National Park would be similar to Denali, Kluane and Waterton. Average number of backcountry user nights per visitor at Auyuittuq is 10, while at other parks is usually 3 or less.

On a parkwide per visitor basis, the data support the hypothesis that Auyuittuq National Park has a higher rate of non-injurious aggressive interactions than any national park that contains black and/or grizzly bears. The sample size is small, however, and therefore caution is needed in drawing firm conclusions. However, for visitors to backcountry areas, the risk of a non-injurious aggressive interaction with a bear at Waterton and probably Kluane, is higher than at Auyuittuq.

The active polar bear detection and deterrent programs at the three National Historic Park and Sites at Churchill have successfully prevented any aggressive interactions or injuries to visitors from polar bears. Certainly without these management actions, the low volume of visitors and the high frequency of polar bears at these sites strongly suggest that there could also be a higher rate of interactions between polar bears and visitors at those sites than in national parks containing black and/or grizzly bears.

No other parks have such an active detection and deterrent program. Because of the large size of Auyuittuq National Park, the cost of a similar program is prohibitive. In all other parks, the primary management actions to separate visitors and potentially aggressive bears once a problem has been reported are area closure to visitors and/or removal of the offending bear.

Although potential visitors to parks may examine these tables to compare the risk of an injurious or non-injurious interaction with a bear in different parks, the data have different implications for individual park managers. From these data, park managers can anticipate the annual number of situations they must be able to respond to. They can also evaluate the effectiveness of their present management techniques to separate bears and people. For example, Kluane National Park had the highest rate of injurious interaction, but a park manager would anticipate only one injury over a 5 year period if he compares rate with mean number of vistors per year. In contrast, the rate of injurious interaction per park visitor at Great Smoky Mountains National Park is much lower than Kluane, however, the park manager knows that he will have to respond to an average of four incidents each year during which a visitor is injured by a bear.

3.2 Polar bear habitat use

In this section we investigate the hypothesis that habitat use of an area by polar bears will strongly influence the chance for polar bear - human interactions.

3.2.1 Seasonal habitat use by polar bears

Before we examine the data base in relation to the hypothesis, we present the following summary of polar ecology to educate the reader on seasonal habitat use by polar bears.

Polar bears, like other species of bears, are also creatures of habit. Unlike other species of bears, the annual wanderings of polar bears do not fit into definable home ranges that are reused year after year, however, polar bears do display seasonal fidelity to particular habitat types and locations. Thus habitat use of certain areas by polar bears is somewhat predicatable and knowledge of the location of these areas can be used by people to reduce polar bear - human interactions.

The distribution of polar bears among habitat types changes seasonally. Between freeze-up and break-up, polar bears wander over sea ice hunting their primary prey species, ringed seal (Phoca hispida) and bearded seal (Erignathus barbatus) (DeMaster and Stirling 1981). Ice types, and sex and age of seals, strongly influence the distribution of both seal species (Stirling and Smith 1975). Polar bears tend to concentrate where seals concentrate. This is where sea ice is periodically active -- the interface between landfast ice and drifting pack ice, across the mouths of bays, or in tidal zones along coastlines (DeMaster and Stirling 1981).

During November and December, most pregnant female polar bears move inland to occupy maternity dens. These dens are excavated in deep snowbanks (Stirling et al. 1984) but in the Churchill area, they may be dug in soil as well (Stirling et al. 1977). Cubs are born in the dens and the family group emerges in late March or early April. They remain in the vicinity of the den for 1-2 weeks and then trek across the land onto the sea ice to hunt seals (Stirling et al. 1984).

In mid to late April, seal pups are born in sea ice lairs (Stirling and Smith 1975). Most polar bears tend to travel along snow-drifted pressure ridges in the offshore ice preying primarily on seal pups and nursing females and subadult seals. Female polar bears with small cubs may restrict their hunting to the more stable shorefast ice. At this time of year, polar bears deposit a tremendous fat layer in anticipation of the summer when hunting opportunities are few to non-existent (Schweinsburg et al. 1977).

Throughout break-up, polar bears continue to hunt seals and move to bays where the ice remains longest or they follow the retreat of the permanent ice pack (Stirling et al. 1984). When the last of the ice is gone, polar bears come ashore to loaf until freeze-up. They are exceedingly fat and spend most of their day sleeping (Lunn 1985).

In areas where the sea ice melts, polar bears (especially family groups, single females and subadults of both sexes) concentrate on land adjacent to where the ice melted last. These areas are known as summer retreats and they are consistently used from year to year. Fidelity to these sites has been documented (Stirling et al. 1984). Many adult males appear to spend much of the summer drifting on ice floes (Schweinsburg et al. 1977). In Hudson Bay where the ice melts completely, all sex and age groups come ashore.

As temperatures drop below freezing again, polar bears may concentrate along certain shorelines waiting for ice to form so that they can begin hunting seals again. The best known example of this is the concentration of polar bears that occurs along the coastline between Churchill and Cape Churchill. Once the ice forms, the bears move out and the cycle repeats.

3.2.2 Polar bear density and aggressive polar bear - human interactions in Canadian and American national parks

We tested the habitat use -- polar bear - human interaction hypothesis by comparing trends between the mean number of polar bears counted during surveys along the coastline from Churchill to York Factory and the total number of polar bear - human interactions (injurious and non-injurious) that occurred in the same area during the months of August, September, October and November when the bears are stranded onshore (Fig. 2). The trends are the same at a significance level of 0.005 but are different at 0.05 (x^2 =11.7, df=3). We feel that these data tentatively support the second hypothesis and demonstrate that interactions between bears and humans increase as polar bear concentrations increase.

Polar bear concentrations along the Manitoba coastline during fall are higher than any other known seasonal concentration. From the perspective of polar bear habitat use, we feel that there is more potential for a polar bear - human interaction at the National Historic Park and Sites at Churchill than other existing or proposed northern Canadian

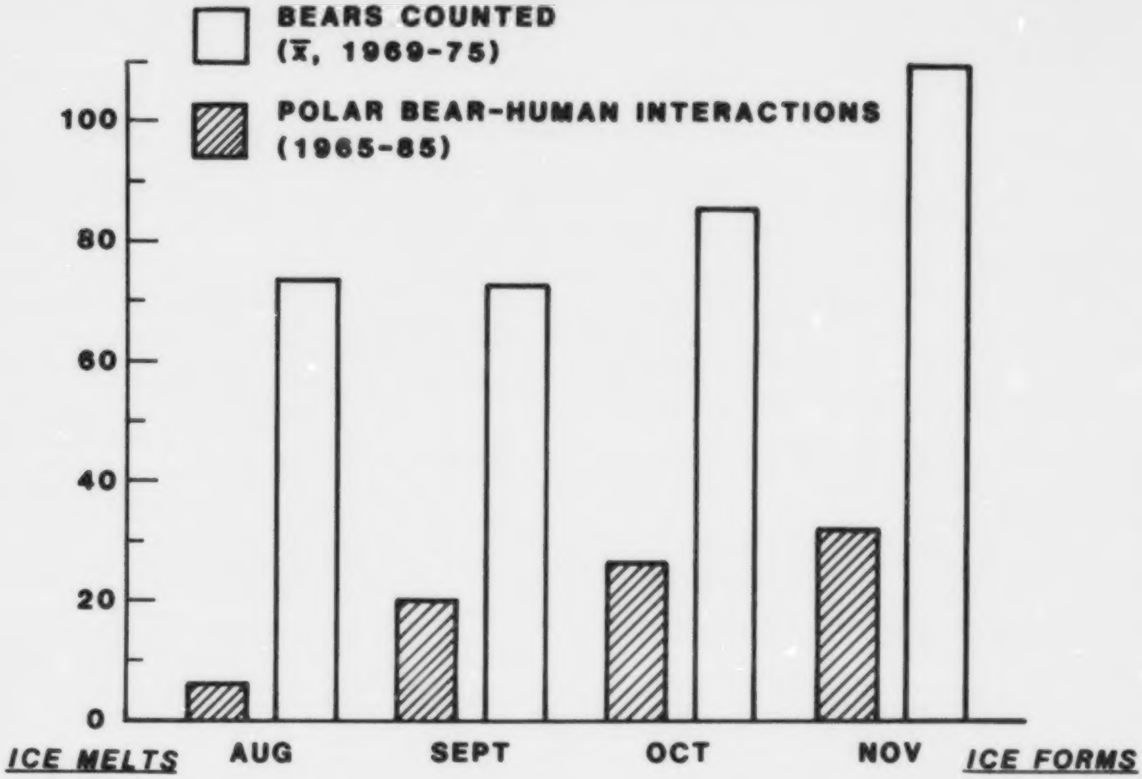

Figure 2. Bear density and aggressive polar bear - human interactions (1966-1985) between August and November in Manitoba.

national park. However, we emphasize that as in southern parks, visitors and park managers must recognize that potential for aggressive interactions exists anywhere polar bears and people overlap.

Approximately 1,300 people reside in Churchill which is similar to other coastal settlements in the Northwest Territories. Of the aggressive interactions that occurred between Churchill and York Factory between 1966 and 1985, 72 (87%) occurred within Churchill or its satellite communities, presumably because this area has the highest concentration of people. Eleven interactions occurred along the coastline at hunting or research camps. These data suggest that the number of interactions between polar bears and humans is also related to human concentrations. The data did not allow us to evaluate whether rate of interaction is influenced by polar bear and/or human densities or whether one type of activity is more risky than another.

3.2.3 Important polar bear habitat in existing and proposed northern Canadian national park lands

To a large extent, use of different kinds of habitat by polar bears is predictable. Maternal denning areas, summer retreats and fall staging sites have the highest concentrations of polar bears. Bears appear to display fidelity to these sites (Stirling and Ramsay 1986).

Occasionally, an unpredictable temporary concentration of polar bears may occur. This usually results when bears congregate opportunistically to scavenge at a beached whale or walrus carcass.

These habitat types exist within a number of the existing and proposed National Park sites (Table 6, App. 1). With two exceptions, wherever these areas overlapped with human use, non-injurious aggressive interactions between polar bears and humans occurred (App. 1). None have occurred in the Northern Yukon National Park Reserve probably because no people visit the area when the females are denning and none have occurred at the National Historic Park and Sites near Churchill because of management actions that keep bears and visitors apart.

The knowledge that polar bears will concentrate seasonally in predictable areas and that polar bear density influences the number of interactions can assist the park manager to develop guidelines for park use by visitors to minimize risks for tourists. Surveys should be conducted within each northern park to confirm areas used annually by polar bears for maternal denning, summer retreats and fall staging sites. A minimum of two years of data is suggested. Since

Table 6. Important polar bear habitat located in existing or proposed National Parks, Historic Parks, and Historic Sites in Canada.

National Parks, Historic Parks, and Historic Sites	Maternity denning areas	Summer retreats	Fall staging site
A. Existing parks			
Northern Yukon	X	-	-
Auyuittuq	X	X	s
Prince of Wales, Cape Merry, Sloop's Cove (Manitoba)	-	X	X
York Factory (Manitoba)	-	X	-
B. Proposed parks			
Thompson River, Banks Island	s	-	-
Bjorne Peninsula, Ellesmere I.	s	s	-
Northern Ellesmere	-	-	-
Pond Inlet, Baffin Island	X	X	-
Wager Bay, Keewatin	X	X	s
Owl River, Hudson Bay Lowlands	X	X	-

X habitat type is present
s presence of habitat type is suspected. More data are required to confirm use by polar bears.
- habitat type is not present

opportunistic gatherings of polar bears to scavenge on large carcasses cannot be predicted, park managers should determine whether this is likely to occur. If so, contingency plans should be available to respond to such an event.

Even if visitors take all the necessary precautions, aggressive interactions may be unavoidable when humans are active in the vicinity of polar bears.

3.3 Curiosity in the polar bear

Absence of attractants during interactions could not be used to test the hypothesis that polar bears are more curious than black and grizzly bears because even without attractants, approach could suggest either curiosity or that a polar bear considered a person to be either a threat or potential prey. We were therefore unable to collect data that could be used to test the hypothesis. However, we collected anecdotal information from polar bear biologists and hunters that demonstrated that polar bears, like grizzly and black bears (Herrero 1985:202; Bacon 1980), are curious (App. 2).

The behaviour of a curious polar bear is similar to that of a curious black or grizzly bear or dog (Bacon 1980). A polar bear investigating something different will stand usually on all fours and move slowly towards or around the object, stopping frequently to sniff the air and look around. The head will be held high with ears forward or sticking out and the bear will move its head around to try to catch a scent. Like other bear species or a dog, a polar bear will often circle downwind to catch the scent of the object of interest and approach from this direction. This behaviour is often initiated from quite a distance (150 or more m) (App. 2).

Like grizzly and black bears, polar bears sometimes stand up on their hind legs to investigate an object. If this is combined with some of the behaviour described previously, a bear is probably just being curious. However, standing up on their hind legs is also used during some types of aggressive behaviour such as mock fights, real fights, and occasionally before initiating a charge (App. 2).

Black bears, when presented with a new object (that was not a food item) in their cage, "... would approach, smell the object, manipulate it with their forepaws, and then begin to chew on it." (Bacon 1980). This behaviour again is similar to that of a dog and has been observed at the Cape Churchill research tower in polar bears investigating foreign objects that are not food items (G. Stenhouse, P. Clarkson, pers. comm.).

Everyone who was interviewed agreed that polar bears are exceedingly curious (App. 2). Several biologists felt that the reason for such curiosity was linked to a polar bear's constant search for food. Thus anything that was out of the ordinary could potentially be a food item and needed to be investigated. Polar bear tracks followed from a helicopter sometimes veered off where a bear had spotted a dirty piece of snow or an abandoned fuel barrel and then returned back to their original course after the object was investigated (J. Lee, R. Schweinsburg, pers. comm.). Even bears during the ice-free period (when they are fat and essentially fasting) still exhibit this behaviour.

Several people also commented on the relative unfamiliarity of polar bears with humans. Because most polar bears rarely contact people (this situation differs to some extent at Churchill), the exceedingly curious nature of a polar bear implies that a polar bear upon seeing a human will not necessarily run away but may approach closer. As Bacon (1980) says, "The conscientious removal of food without regard to the bear's innate curiosity may not eliminate potential conflict."

3.4 Behaviour and proximity of polar bears during an aggressive interaction

We could not directly evaluate the research hypothesis that polar bears normally approach quite close to investigate an unidentified object without having aggressive intentions because only interactions where polar bears were perceived to have acted aggressively were analyzed. Anecdotal information suggests polar bears do investigate objects quite closely without displaying aggressive behaviour (App. 2).

We did ask polar bear biologists whether they would be concerned if a bear was 20 m away (App. 2). Most, if not all, have had polar bears approach at least to this distance without the bear overtly acting aggressively. Often just the sound of their voice turned the bear away. They said that they would be concerned if the bear had approached steadily from a long distance off and attempts to deter the bear had been unsuccessful. If the interaction had elements of surprise and the bear's behaviour implied curiosity, then the biologists said they would not be unduly concerned. However, they all agreed that there would be virtually no time to react if a bear charged from 20 m. If a bear was within 20 m, they would watch its behaviour closely and have their firearms ready.

All biologists familiar with Churchill bears would not be overly concerned if one of these bears came within 20 m because these bears appear to be quite tolerant towards humans. Possible explanations given by biologists for this tolerance were the potentially more frequent contact with people, the lack of hunting, and/or the somnolent state of a bear during the ice-free period. However, the biologists would still monitor the bear's behaviour and have a firearm with them. They said that they would not feel this way if a bear approached them this closely out on the sea ice where it is actively hunting.

We examined the nearest approach made by a polar bear before it was killed in a non-injurious aggressive interaction to determine how close a bear had to come before a person would shoot it. Although we had no data for 65 percent of these interactions, in 80 percent of the remaining 104 interactions, the bears approached within 10 m before they were shot (Table 7). There was no difference in approach distance between Inuit, who are very familiar with polar bear behaviour, and non-Inuit. This suggests that most armed humans do not feel particularly threatened by a polar bear until it is quite close (within 10 m). Unfortunately, we have no data to determine whether humans demonstrate equivalent tolerance to the close approach of a black or grizzly bear.

Table 7. Closest approach of a polar bear during a non-injurious aggressive interaction in the Northwest Territories or Manitoba which resulted in the bear being killed.

Distance from bear to human (m)	Northwest Territories Inuit (%) (n=49)	Northwest Territories Non-Inuit (%) (n=42)	Manitoba (%) (n=25)
1-5	58	62	68
6-10	18	22	20
11-50	20	14	8
51-100	2	2	4
101-250	2	-	-

Table 8. Closest approach of a polar bear during a non-injurious interaction in relation to reason given for killing bear

Reason	1-5 m (%) n=68	6-10 m (%) n=24	11-50 m (%) n=20	51-100 m (%) n=3	101-250 m
Self defense	57	55	40	-	-
Defense of property	16	17	10	*	-
Injured because of deterrent attempt	8	4	5	*	-
Would not leave	10	8	20	*	-
Problem in Churchill	3	8	5	-	-
Public safety	6	8	20	-	-

* sample size too small to use

In the accounts of aggressive, non-injurious interactions, we searched for statements that explained why a bear had been killed and what behaviour the bear had first exhibited during the interaction. We found that, at all distances, the reason given most frequently for shooting a bear was self defense (Table 8). We grouped the perceived initial behaviour of the bear into three categories that describe the anticipated response of the person(s) involved to the observed behaviour of a bear:

a. self defense - bear exhibited aggressive behaviour;
b. defense of property - bear destroyed equipment or food cache; and
c. other - bear did not appear to have acted aggressively initially.

Three quarters of people did not shoot a polar bear that was acting aggressively towards them until it was within 5 m of them (Table 9). People tended to shoot a bear from a farther distance if it was destroying property. Fifty percent of bears whose behaviour was not initially aggressive were still killed for self defense reasons although only three (7%) bears displayed aggressive behaviour subsequently (in reaction to deterrents), however, all except three bears had approached within 10 m of the person. These results corroborate the suggestion that a

Table 9. Closest approach of a polar bear that was killed during a non-injurious aggressive interaction in relation to initial perceived behaviour of a bear and anticipated response by person(s) involved.

	Anticipated response (to behaviour of bear)		
Closest Approach (m)	Self Defense (Aa, Aq, As, Be, Cp, Gr, Tt) (%) n=43	Defense of Property (Ad, De, Fc, Fg) (%) n=18	Other (At, Aw, Ic, Sl) (%) n=43
1-5	77	56	49
6-10	9	17	28
11-50	12	27	19
51-100	2	-	2
101-250	-	-	2

Bear Behaviour

Aa - acting aggressively
Aq - approaching quickly
As - approaches in stalk position
Be - breaking and entering tent
Cp - charging person
Gr - growling
Tt - tugging on tent wall

Ad - attacking dogs
De - destroying equipment
Fc - feeding on cached carcasses
Fg - feeding on garbage
At - approaching camp or people
Aw - approaching from downwind
Ic - investigating camp
Sl - stopping and looking

polar bear must approach a person closely before the person feels endangered.

We also examined the nearest approach made by a polar bear during a non-injurious aggressive interaction that ended with the bear leaving. Deterrents were used in each situation. In the ten (42%) interactions for which we had data on proximity, eight bears (80%) came within 10 m of the person before leaving. Five of these bears displayed aggressive behaviour.

Since three-quarters of the bears involved in non-injurious aggressive interactions for which closest approach distance is known were within 10 m of the person, it appears that when a bear is this close, it is either acting aggressively towards a person or, if it is not displaying aggressive behaviour, its close proximity causes the person to feel endangered. This has implications for the park manager. At times, polar bears do approach quite closely to investigate something without having aggressive intentions. Secondly, when polar bears come within 10 m of people, that is too close no matter what the intention of the bear is. Park managers through educational pamphlets can alert people to this investigative behaviour of polar bears, however, it is unlikely that knowledge of this behaviour will placate someone once a bear approaches within

10 m, especially if they have only non-lethal deterrents in hand.

However, we do wish to emphasize that these conclusions are from analysis of aggressive interactions. The biologists interviewed felt that most polar bears will avoid humans once they identify a distant object as a person. Bears can easily do this from a distance of 100-150 m either visually or by scent (P. Clarkson, pers. comm.). If they continue to approach, their behaviour must be closely observed and a deterrent will probably be required to make them leave.

Black bears, when exploring for food, will sometimes approach quite closely to investigate an unidentified object (Herrero 1985). It is quite likely that the close approach of a polar bear that is not acting aggressively may be for the same reason.

Grizzly and black bears may also bluff charge and stop within 10 m of a person or even closer. Most people would be uncomfortable this close to a grizzly bear as it would probably be acting aggressively (unlike a polar bear) if it was aware of the person (Herrero 1985).

3.5 Age, sex, and condition of polar bears involved in aggressive interactions

Twenty bears injured humans. Of these, the sex and age of three bears were not recorded but two were probably adult males. We defined adult bears as those capable of breeding (i.e. 5 years and older). In the Northwest Territories, adult male and female polar bears mauled more humans than subadult bears while in Manitoba, subadult males mauled more humans than other sex and age class (Table 10).

Sex and age were determined for 251 (78%) bears that were killed during a non-injurious interaction. In both the Northwest Territories and Manitoba, subadult males were at least twice as likely to become involved in an aggressive interaction as any other sex and age class (Table 10). In the Northwest Territories, subadult females were involved in the fewest number aggressive interactions while in Manitoba this cohort caused more problems than either adult males or females. Our results agree with Stenhouse et al. (in prep.) although they define adult bears as six years and older.

We compared these results to the sex and age distribution (Table 10) that was derived from ages of bears captured during population studies (J. Lee, pers. comm.). To make the data comparable to our results, we excluded

Table 10. Sex and age classes of polar bears involved in injurious and non-injurious interactions in relation to sex and age classes of polar bears captured during population studies.

Sex	Ageclass *	Bears that injured humans NWT (%) n=8	Bears that injured humans Manitoba (%) n=8	Bears that were killed but did not injure humans NWT (%) n=163	Bears that were killed but did not injure humans Manitoba (%) n=88	Normal distribution in population NWT (%) n=2411	Normal distribution in population Manitoba (%) n=1363
Male	Subadult	22	63	40	49	18	31
	Adult	33	25	25	16	30	18
Female	Subadult	12	-	12	25	19	22
	Adult	33	12	23	10	33	29

* estimates of age class and, when available, real ages were used to determine whether bear was an adult (5 years or older) or subadult (1-4 years)

cubs-of-the-year (COYs) from both subadult classes. In any aggressive interaction that involved COYS, it was always the mother, not the COYs, that was perceived as the aggressive bear.

In the Northwest Territories, capture of bears to determine population estimates is usually undertaken in the spring on sea ice when all sex and age classes of bears are available. This results in a sex and age distribution that is representative of the population. However, in Hudson Bay, sea ice and weather conditions are not conducive to spring capture programs (Stirling and Ramsay 1986). Most bears have been captured on land when the sex and age classes are segregated in their distribution (Stirling and Ramsay 1986). Thus, the sex and age distribution for Manitoba polar bears represents the relative proportion of bears on land and not the entire subpopulation (Table 10).

When we compared the sex and age distribution among the three categories (injurious aggressive interaction, non-injurious aggressive interaction, and "normal" population), we found that the sex and age distribution of bears that injured people in the Northwest Territories was proportional to the population structure (Fig. 3). However, proportionately more subadult males were involved in non-injurious interactions in comparison to their

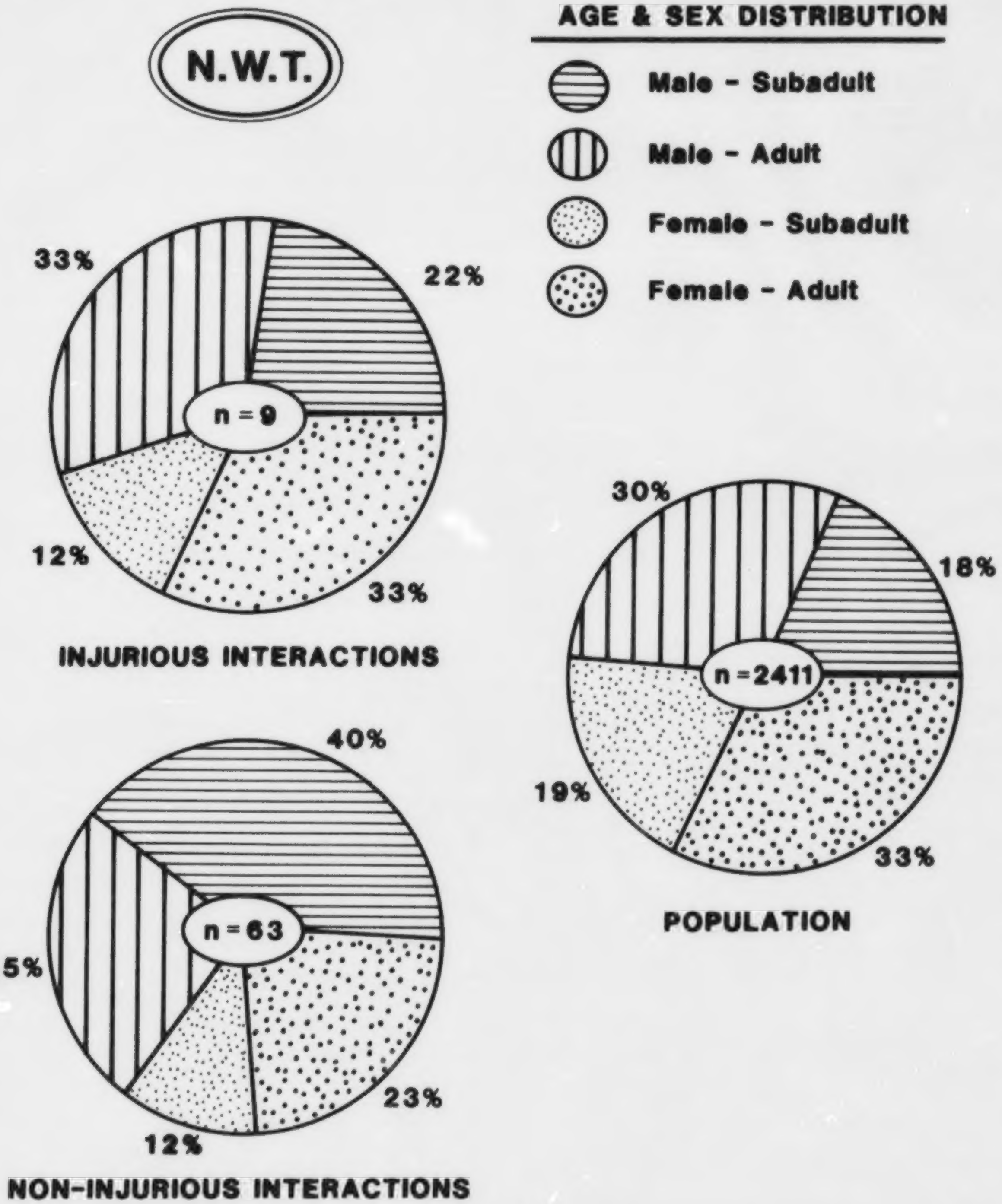

Figure 3. Sex and age class of polar bears involved in injurious and non-injurious aggressive interactions in the Northwest Territories (NWT) in relation to sex and age class of the NWT polar bear population as determined from mark-recapture studies.

representation in the population structure. When comparing sex and age distribution between injurious and non-injurious aggressive interactions in the Northwest Territories, although the sample size is small, it appeared that adult males and females are slightly more likely to injure a human during an aggressive interaction than subadult bears.

In Manitoba, the sex and age distribution of bears that injured people was not proportional to that observed in the population. Proportionately more subadult males caused injury even though they are the largest cohort in the population while proportionately fewer subadult and adult females caused injuries (Fig. 4). In non-injurious interactions, subadult males are still overrepresented in comparison to the population structure, however, the proportion of subadult females is similar. Comparison of sex and age distribution between injurious and non-injurious aggressive interactions suggests that, in contrast to the Northwest Territories, subadult and adult males are more likely to injure a human if involved in an aggressive interaction. Again, the small number of injurious interactions makes the inference preliminary.

Physical condition of the bear was recorded in 97 (30%) interactions. Although many bears involved in aggressive interactions appear to be in normal physical condition, the

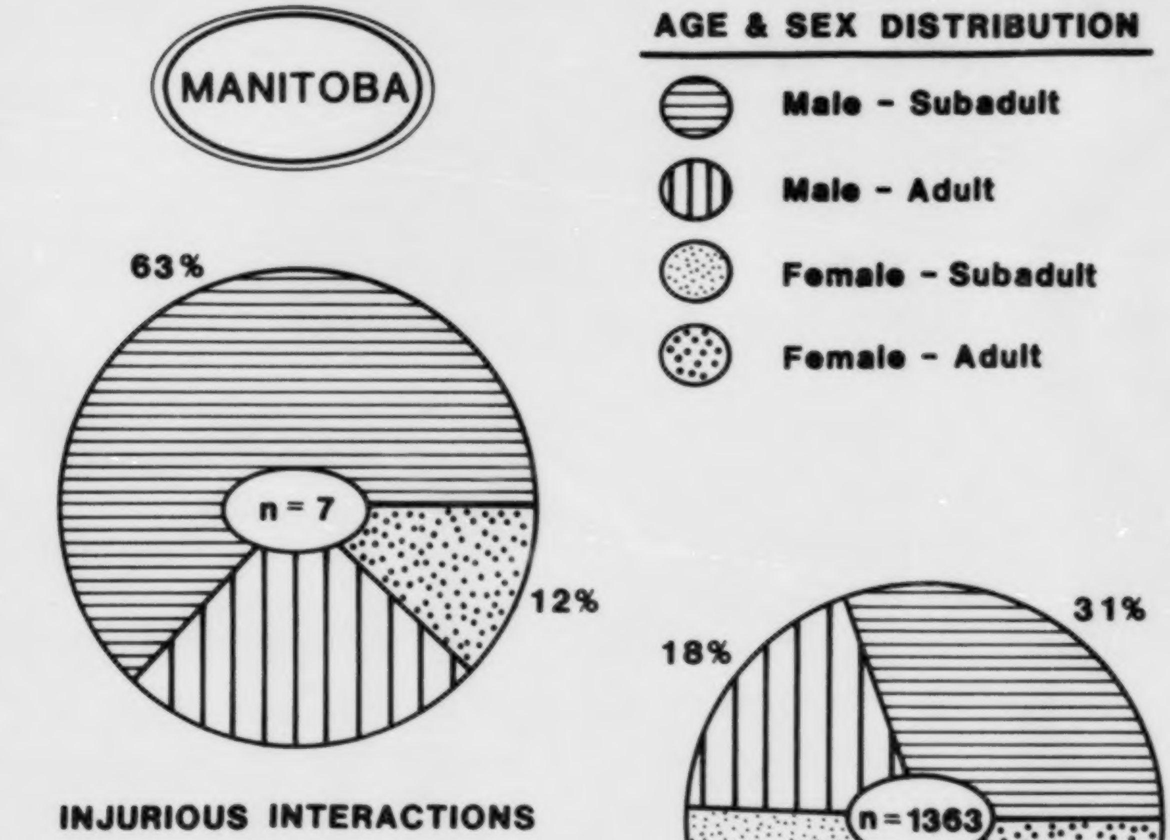

Figure 4. Sex and age class of polar bears involved in injurious and non-injurious aggressive interactions in Manitoba in relation to sex and age class of the Manitoba polar bear population as determined from mark-recapture studies.

relative proportion of thin bears was much higher than that observed in a population (J. Lee, pers. comm.) (Table 11). Of known age animals, more adult bears older than 15 were thin (50%) than adult bears younger than 15 (26%). It appears that physical condition of bears involved in injurious and non-injurious aggressive interactions is similar, however, the sample size for bears that injured people is too small to evaluate whether condition influences risk of injury to a human during an aggressive interaction. Thus, like grizzly bears, poor physical condition increases the likelihood of a polar bear's involvement in an interaction (Herrero 1985), but it is not the only factor involved.

The data support the hypothesis that age, sex, and condition influence a bear's potential involvement in an aggressive interaction. A human involved in an aggressive interaction has a slightly higher chance of injury in Manitoba if the bear is a subadult or adult male while in the Northwest Territories, it is slightly higher if the bear involved is an adult male or adult female. Thus it appears that age and sex of a bear may also affect the likelihood of human injury during an aggressive interaction. However, the small sample size of injurious interactions makes this conclusion tentative.

Table 11. Physical condition of bears that (a) caused human injury; and (b) were killed during a non-injurious aggressive interaction.

Physical Condition	Male				Female	
	Subadult		Adult		Subadult	Adult
	(a)	(b)	(a)	(b)	(b)*	(b)+
	(%) n=5	(%) n=37	(%) n=3	(%) n=19	(%) n=18	(%) n=14
Thin	40	32	67	53	33	36
Normal	40	43	33	32	40	43
Fat	20	-	-	-	6	14
Injured	-	11	-	5	15	
Empty stomach but not thin	-	14	-	5	-	7
Old shotgun pellets in hide	-	-	-	5	6	-

* - no subadult females injured humans

+ - condition of only one of five adult females that was involved in an injurious interaction was recorded. She was in normal physical condition.

Although these data are of interest when developing a descriptive model of polar bear - human interactions, they have little practical application for the park manager or visitor because it is rarely possible to determine the sex, age, or condition of a polar bear without killing the bear. Since even a 2 year old polar bear which weighs at least 100 kg (J. Lee, pers. comm.) is large enough to be very dangerous to a human, it is important to recognize that any polar bear has the potential to be involved in an injurious or non-injurious aggressive interaction.

3.6 The predaceous polar bear

The research hypothesis that polar bears rarely exhibit overt aggressive behaviour before an attack on people implies that polar bears attack people with the intention of consuming them. Several kinds of data support this conclusion.

Polar bears do have a repetoire of aggressive behaviours that include vocalizations, body posture and body movements (App. 2). These are similar to those used by an aggressive grizzly or black bear, dog, or cat and most people would be able to recognize them. The most common signs of an agitated polar bear are: (1) a loud huffing or blowing sound; (2) snapping its jaw to make oud popping or chomping sounds; (3) staring directly at you; and (4) lowering its head so that it is below shoulder level, the ears are back and are pressed against the head. The head may be swaying back and forth sideways. However, all the biologists and hunters interviewed stressed that bears may not show any of these warning signs before charging. In contrast to black and grizzly bears (Herrero 1985), bluff charges towards humans appear to be very rare but have been known to occur. Usually these seem to be initiated by subadults and females with cubs. Stirling (1974) reported females with cubs bluff charging adult males and adult males charging subadults to displace them from seal kills.

Polar bears have two main hunting patterns: (1) still hunting where they sit beside a seal hole and wait before the pounce; and (2) stalk, rush, and pounce (Stirling 1974). After capturing a seal, polar bears bite them several times on the back of the head and neck (Stirling 1974). The situations described by victims and investigators suggest that both methods have been used during attacks on people (App. 3).

Polar bears hunting their normal prey (seals) did not vocalize. Neither did any of the bears that injured humans. This too, contrasts with black and grizzly bears (Herrero 1985). The lack of any warning noises by the polar bears further suggests that these bears were hunting.

We analyzed 373 injurious and non-injurious aggressive interactions that occurred either in the Northwest Territories or in northeastern Manitoba (Fig. 5). In the analysis, we also included one non-injurious interaction that occurred off the coast of Alaska and one injurious interaction that occurred near Svalbard, Norway. The majority of these interactions occurred between 1970 and 1985. Aggressive interactions between polar bears and humans have occurred throughout the remaining range of polar bears, however, records are either not kept or were not accessible to us (App. 4).

People were killed or injured in 20 (5%) of the interactions. Thirteen men, two boys, and one woman were injured and five men and one teen-aged boy were killed. Although we stated earlier that only four deaths have occurred in Canada in the last 15 years, we also included one death that occurred in Canada more than 15 years ago and one death that occurred near Svalbard, Sweden in order to increase our sample size for analysis (App. 3). Four victims were Manitoba treaty Indians, six were Inuit (two died), and twelve were white (four died). Eleven injurious interactions occurred in the Northwest Territories, eight injurious interactions occurred in northeastern Manitoba, and one near Svalbard.

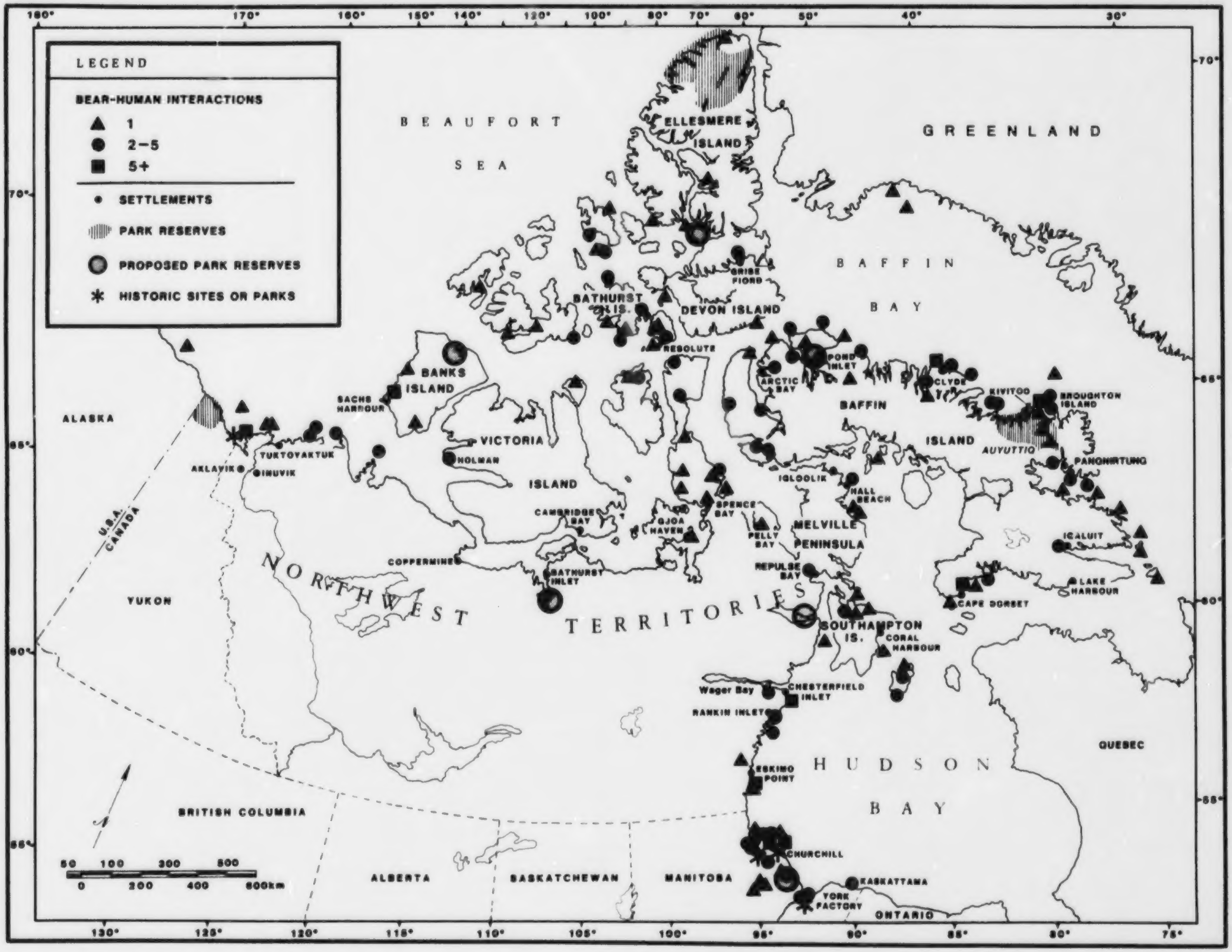
LEGEND
BEAR-HUMAN INTERACTIONS
▲ 1
● 2–5
■ 5+
• SETTLEMENTS
▨ PARK RESERVES
◉ PROPOSED PARK RESERVES
✱ HISTORIC SITES OR PARKS
BEAUFORT SEA
GREENLAND
BAFFIN BAY
ELLESMERE ISLAND
GRISE FIORD
DEVON ISLAND
BATHURST IS.
RESOLUTE
BANKS ISLAND
SACHS HARBOUR
VICTORIA ISLAND
HOLMAN
CAMBRIDGE BAY
COPPERMINE
BATHURST INLET
GJOA HAVEN
SPENCE BAY
PELLY BAY
ARCTIC BAY
POND INLET
CLYDE
KIVITOO
BROUGHTON ISLAND
AUYUITTIQ
PANGNIRTUNG
BAFFIN ISLAND
IGLOOLIK
HALL BEACH
MELVILLE PENINSULA
REPULSE BAY
SOUTHAMPTON IS.
CORAL HARBOUR
CAPE DORSET
ICALUIT
LAKE HARBOUR
QUEBEC
Wager Bay
CHESTERFIELD INLET
RANKIN INLET
ESKIMO POINT
HUDSON BAY
CHURCHILL
KASKATTAMA
YORK FACTORY
ONTARIO
MANITOBA
SASKATCHEWAN
ALBERTA
BRITISH COLUMBIA
YUKON
NORTHWEST TERRITORIES
ALASKA
U.S.A.
CANADA
TUKTOYAKTUK
AKLAVIK
INUVIK
0 50 100 200 300 400 500 600km
180° 170° 160° 150° 140° 120° 100° 90° 80° 70° 60° 50° 40° 30°
70° 65° 60° 55°
130° 125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75°

Figure 5. Location of aggressive polar bear - human interactions in the Northwest Territories and Manitoba between 1966 and 1985.

Fifteen victims received head or neck wounds, five victims were wounded elsewhere and type of injury could not be determined for two victims. Five of the six victims that died were probably killed instantly. Eight (50%) of 16 victims who were not killed were hospitalized for more than 24 hours. Four received minor injuries and length of hospitilization was unknown for four people.

We defined a serious injury as one that required more than 24 hours hospitalization. The rate of serious injury from polar bears is the same as that for grizzly bears while only 10 percent of injuries from black bears are serious (Herrero 1985).

Typically, head or neck wounds were caused by nine of the ten male polar bears while only one of the five female bears inflicted head or neck wounds on their victims. In this case, the scalp wound appeared to have been caused by the female's claws and not her teeth (E. Langevin, pers. comm.)

Five bears consumed part of their victim. Four of the victims died. Three of these five bears were adult males, one was a subadult male, and the age and sex of the fifth bear was unknown, but we suspect it was an adult male. In that situation, people were camping near a glacier in Svalbard. During the night, one camper heard a noise and popped his head out the door (looking like a seal emerging from a hole). A very large bear picked him up and carried him over to an iceberg and proceeded to consume him. Two other bears that killed people were themselves killed before they had a chance to consume their victim.

Three females with offspring ended the attack on their own initiative. In two interactions, the females were surprised at very close quarters by the sudden appearance of a human (one in shrub tundra and the other when a person walked over the roof of a den). In the third interaction, two hunters were chasing two polar bears. The young bear was killed and the female then surprised the hunters by attacking one of them. The remaining female with a cub was surprised by the appearance of two men while she was investigating a refuse sump at night at an exploration camp. She continued her attack until she was killed. The fifth female (subadult) grabbed a man as he lay on the ice in his sleeping bag. When another man jumped out of his sleeping bag, she began to charge him and was shot.

One yearling male bear ended his attack on his own initiative, but the other eleven male bears continued the attack until they were killed, the victim was killed or the victim was rescued.

In two cases, male polar bears that attacked Inuit did not seem to be dissuaded by a human who fought back, however, this probably gained valuable time for the victim so that someone else could kill the bear. One white victim fought back during an attack but this did not cause the female bear to retreat. Observers felt that his wounds would not have been nearly as severe if he had not struggled so hard to free himself from the female who was accompanied by a cub (E. Langevin, pers. comm.)

One young boy played dead and the yearling male bear left. In six other attacks, victims did not appear to struggle but were still injured. Adult females with cubs were involved in two of these. The females did not continue after their initial attack. One subadult female, and one subadult and two adult males were involved in the other four interactions. They continued their attack until they were killed.

None of the polar bears that mauled humans gave obvious warning signals. This could mean either that a bear was surprised by the sudden appearance of a human or that it did not want to warn its "potential prey." In only two of 19 injurious interactions were the victims aware of the bear before it began its charge or attack -- one person was hunting the bear and the other went outside his house to look for the bear (Table 12). Four victims were sleeping and woke to see or hear the bear near them. Two people were mauled while walking through Churchill, one was killed while following fresh tracks near Churchill, and two were injured while walking through bush. One person was injured when he fell through the roof of a female's den. The others were absorbed in some activity.

In contrast to injurious interactions, in one half of the interactions where humans were not mauled, people were not visible to the bear because they were inside a tent or house, either sleeping or absorbed in some other activity (Table 12). This suggests that half the bears were probably unaware of humans prior to a non-injurious interaction and thus, unlikely to have had predatory intentions.

Black bears do not appear to be as stealthy as polar bears. The potential victim is sometimes made aware of the bear as it circles and watches him before charging. Depending on the type of attack, grizzly bears may or may not display warning signals (Herrero 1985). Unlike our data on polar bears, during sudden encounters, grizzlies will often give warnings. However, eight of the 12 deaths that occurred in Banff, Glacier (Montana), and Yellowstone National Parks since 1967 happened at night and the bears attacked without warning, apparently in a predatory manner. Six out of the seven bears responsible had learned to exploit people-related foods. All of the bears were habituated to people, having lost their avoidance of them (Herrero in prep.).

Table 12. Activity of people involved in aggressive interactions when they first became aware of the approaching polar bear(s).

Activity	Injurious interaction (%) n=19	Non-injurious bear(s) killed (%) n=146	Non-injurious bear(s) not killed (%) n=17
sleeping	21	32	24
inside tent or house	5	22	24
hiking or skiing	11	-	24
walking through town	11	-	-
working around an industrial or hunting camp	21	16	18
handling food	5	3	-
hunting, setting traps, fishing	11	7	-
observing bear(s) from distance	-	9	5
knowingly approaching bear	5	1	-
at maternal den site	5	1	-
other	5	9	5

We considered wounds in the head or neck area and consumption of human flesh to be indicative of a bear attacking a human as prey. In nine of 11 injurious attacks by male polar bears, one or both of these indicators were present. A tenth male bear attacked a man by hiding under a vehicle and jumping up to grab the man's arm as it hung out the window. The bear attempted to pull the man out but the man was rescued. The bear was described as a large, skinny male. We feel these data support the conclusion that the male bears involved in injurious aggressive interactions considered humans to be a prey item. Evidence indicates that all three species of bears can be predators on human beings in certain circumstances (Herrero 1985; Herrero in prep.).

In contrast to male polar bears, females accompanied by young did not appear to have been hunting the people they attacked. The circumstances leading up to the attacks did not suggest predatory behaviour. Instead, all four females were surprised by the sudden appearance of people and the females probably considered the humans to be threatening their offspring. The single head wound inflicted by a female was the result of clawing at the head not biting, and, unlike male bears, two females ended the interaction on their own initiative and a third (at her den site) did not continue her attack when a man escaped.

We also investigated relative aggressiveness of female polar bears accompanied by young with productive black and grizzly bear females. Productive female polar bears were involved in four (20%) of the 20 injurious aggressive interactions and 37 (16%) of the non-injurious aggressive interactions in which sex and age of a bear could be determined. Altogether the proportion of productive to nonproductive adult female polar bears (77:23) is similar to that of a normal population structure (67:33) (J. Lee, pers. comm.)

Research biologists in Great Smoky Mountains National Park determined that productive female black bears accounted for 17 percent of the 107 injurious interactions but only 6 percent of non-injurious interactions (Herrero 1985:103). These data suggest that female polar bears accompanied by young are more aggressive than productive black bear females.

Six productive female polar bears were involved in sudden encounters. Five of these occurred at their den sites or in known denning areas. All six females reacted aggressively and humans were injured during four of those interactions. Grizzly bear females with young also act aggressively during sudden encounters. Out of 27 injurious sudden encounters with grizzly bears, productive female grizzlies were responsible 20 times (77%) (Herrero 1985). In contrast, productive black bear females rarely react aggressively during sudden encounters (Herrero 1985).

The single subadult female polar bear that attacked men that were lying on the ice in their sleeping bags may have mistaken the men for sleeping seals. She had approached very quietly, however, unlike the male polar bears that killed a human, she made no quick attempt to kill her victim. Instead, she dragged him by the arm away from the group and dropped him when she saw one of the other men moving. The circumstances suggest that at least initially, she was hunting them.

The data suggest that the intent of a male polar bear during an injurious interaction is to kill the person. Single adult female bears have not been involved in attacks on people. To date, only adult female polar bears accompanied by young have attacked people. It is most likely that they viewed the human as a direct threat to their cubs. A person has a good chance of surviving an attack from a female polar bear that is accompanied with young. This is similar to sudden encounters with grizzly bear females with young (Herrero 1985).

The data do support the hypothesis that polar bears rarely exhibit overt aggressive behaviour before an injurious attack on people. However, lack of warning is not always related to predatory intentions. Female polar bears will act aggressively to protect their offspring and, during sudden encounters, productive female polar bears are likely to injure a human.

3.7 Attractants

We defined the term "attractant" as any item other than a human that was a potential source of food. No attractants (other than the victim) were apparent in 11 (55%) of the 20 injurious interactions (Table 13). However, three of these situations involved female polar bears with cubs. Two of these interactions were sudden encounters with the family group (one at a den site and one in a denning area) and one was a female protecting her cubs from hunters.

In contrast only 4 percent of non-injurious interactions had no apparent attractants present (Table 13). Eight of these 15 situations involved family groups. Two were females at den sites, three were in denning habitat, two were females with cubs recovering from drugging and capturing procedures, and one family group was travelling along the shore where an Inuk party wanted to camp.

From the discussion in the previous section we assume that these productive females were responding to humans as threats to their cubs and not as potential attractants. If we remove those interactions from the "no attractant"

Table 13. Attractants involved in aggressive interactions between polar bears and humans.

Attractant	Injurious interaction (%) n=20	Non-injurious interaction Bear was killed (%) n=280	Non-injurious interaction Bear ran away uninjured (%) n=24
No attractant (other than victim)	55	6	17
Several types all at one site (e.g. food, garbage, carcasses)	30	34	38
Cached animal carcasses (usually in a camp)	5	25	8
Garbage	5	8	8
Food being cooked or eaten	-	10	4
Other (dogs, live whales, chickens, seals, etc.)	-	5	4
None specified but situation strongly suggests attractants present (e.g. camp)	5	12	21

category then 40 percent of injurious interactions involved no attractants (other than the victim) versus 2 percent of non-injurious interactions.

Garbage, animal carcasses, live animals, and/or food were involved in eight (40%) injurious attacks and most likely also in one other attack that occurred at an Inuit hunting camp (Table 13). Such attractants were involved in at least 80 percent of 304 non-injurious aggressive interactions.

3.8 Use of deterrents

We use the term "deterrent" to mean any action that was directed at a polar bear to dissuade it from its approach but did not injure it intentionally. This definition includes shots fired from a firearm in an attempt to scare the bear rather than injure it. Many types of deterrents were used in the interactions that we analyzed. They ranged from hitting the bear with an object, to rattling pots and pans.

During all 20 injurious interactions, no deterrents were tried before the attack was initiated. In most situations, it was not possible because the bear attacked without warning from close quarters. Gunshots, shouting, or hitting the bear with an object were all unsuccessful in interrupting six maulings. In one instance, the sound of a helicopter engine starting up probably helped to distract a female that was attempting to maul a man who had fallen into her den. In the situation where a bear had jumped up from under a vehicle to grab a man's arm, the bear's hold was broken by hitting it. No deterrents were deployed in the remaining 12 injurious interactions. The victims could not be rescued or retrieved until the bear had been killed.

Deterrents were tried during 227 (89%) non-injurious interactions before the bear was killed. Deterrents were tried only once in 96 (42%) interactions, twice in 57 (25%) interactions, and three or more times in 74 (33%) cases.

We also evaluated whether proximity to the bear influenced the use of deterrents during the foregoing interactions. Deterrents were used in 56 (85%) situations where the bear's closest approach was within 5 m; 18 (90%) cases when the bear approached between 6 and 10 m; 16 (88%) cases for approaches between 11 and 50 m; and, 3 (75%) cases for approaches between 51 and 100 m. It seems that people try to use deterrents whenever a bear appears.

We could not determine the type of deterrent used in 39 non-injurious interactions. Warning shots were the most frequently used deterrent (39%), followed by chase with a vehicle (18%), shouting, teleshot or cracker shells, dogs barking, and dogs chasing the bear (Table 14). Birds bombs,

Table 14. Use of deterrents during non-injurious aggressive interactions between polar bears and humans.

Deterrent type	Non-injurious interaction Bear was killed (%) n=188	Bear left scene (%) n=22
Fire warning shot	39	32
Chase with a vehicle, helicopter, skidoo	18	37
Chase with dogs or dogs barking	10	15
Shouting	12	-
Teleshot or cracker shell	9	4
Other	12	12

shooting flares, and using rubber bullets accounted for only 4 percent of deterrents used. Also used less frequently were a variety of often impromptu deterrents including chasing with a grader, flashing lights, banging pots and pans, slamming doors, throwing objects, and so on.

A deterrent appeared to be successful in 23 (96%) non-injurious interactions. Chasing the bear with a helicopter, skidoo or vehicles drove the bear off in eight (37%) situations, followed by firing warning shots (32%), and barking dogs or dogs chasing the bear (Table 14). Teleshot was used once (4%) as were hitting the bear, shouting and retreating, and shouting and throwing rocks. In the only situation where no deterrent was used, the bear was walking past the camp at a distance of at least 300 m. It is not clear whether the bear had aggressive intentions, however, the researchers felt threatened by its presence.

Comparing use of deterrents between interactions in which the bear had to be killed with those in which the deterrent was successful suggests that chasing a bear with a motorized vehicle is potentially more effective than any other deterrent tried in these situations. However, because of the small sample size of polar bears being deterred, more records of non-injurious aggressive interactions in which a deterrent was successful are required. It is important to realize that almost all of the deterrents used in the interactions we collected are different from the deterrents tested by researchers at Cape Churchill (Stenhouse and Cattet 1984, Clarkson 1987). Hastings et al. (1981) reported that in Yosemite National Park, black bears beginning to enter camps in apparent searches for food could often be deterred by aggressive actions by people.

Bears were injured as a result of deterrent attempts during 49 (19%) non-injurious interactions. Most of these bears were eventually killed or died from their wounds. Almost every time a bear was injured, it stopped approaching and attempted to leave. Five bears (10%) continued to approach or charge although one female with cubs eventually left without injuring the people involved. Two bears stopped approaching but remained within 100 m of the site. Attractants were involved during 46 (94%) of these interactions. These results suggest that polar bears will usually attempt to leave if they are injured during an interaction. Black bears behave similarly when injured, while grizzlies may or may not continue to attack after they are injured (Herrero 1985).

We examined the data to evaluate if some types of people were more likely to injure a bear during a deterrent attempt. Some statements received from Inuit specifically mention that they attempted to shoot the bear in a muscle area where it would hurt but not cripple the polar bear. The intent was to make it go away. In spite of this, Inuit are no more likely to injure a polar bear during a deterrent attempt than anyone else (Table 15). However, in Manitoba, although the sample size was small, it appears that residents, who may or may not be familiar with firearms, were much more likely to injure a polar bear.

Initially we believed that no attractants (other than the human) in an area indicated that a bear was approaching solely out of curiosity. We then developed the research hypothesis that deterrents are more likely to be successful when there are no attractants in the area. We thought that a bear approaching a potential food source would be more determined. However, from the discussion in Section 3.6, it appears that humans are sometimes viewed as attractants (i.e. a potential food source). Since it is not possible to determine when a human is or is not perceived as an attractant, we had difficulty evaluating this hypothesis. As well, the variety of deterrents used complicated interpretation of the data.

We could only collect 23 records of non-injurious aggressive interactions in which deterrents were successful. No attractants were present in four (17%) situations, one of which was a sudden encounter with a female with cubs. She attacked the hikers, was injured, and then left.

Table 15. Profession or ethnic origin of people involved in non-injurious aggressive interactions during which a bear is (a) not injured; and (b) injured by a deterrent.

Profession or ethnic origin	Northwest Territories (a) (%) n=219	Northwest Territories (b) (%) n= 29	Manitoba (a) (%) n=95	Manitoba (b) (%) n=10
Inuit	64	60	-	-
Inuit brought in to deter or kill bear	10	10	-	-
non-Inuit employee at exploration camp	6	-	-	-
biologist	5	7	5	20
geologist	4	10	-	-
wildlife officer	4	-	56	20
suburban resident	1	3	24	60
polar bear monitor	2	3	-	-
non-treaty Indian	-	-	4	-
RCMP officer	1	-	3	-
tourist	2	7	6	-
other	1	-	2	-

In 188 records of non-injurious interactions in which deterrents were not successful, ten (5%) involved no attractants. Bears were injured in four of those situations (three bears tried to leave and one continued to approach) and a fifth involved a drugged female with cubs.

Although deterrents were successful in causing the bear to leave during a number of aggressive interactions, they were not successful on many other occasions. The data hint that deterrents were slightly more succcessful when no attractant (other than the human) was present. To evaluate the hypothesis properly, more records of non-injurious aggressive interactions in which deterrents are successful are required and it must be possible to determine when a human is or is not an attractant.

At Churchill, the cracker shells used by Parks Canada staff to deter bears were less successful than usual when bears were attracted to beached whale carcasses (R. Leonard 1985). This observation led to a recommendation to remove whale carcasses from the vicinity of the National Historic Park and Sites because of limited success of deterrents and increased number of bears attracted to the area (R. Leonard 1985).

Tests of the effectiveness of various deterrents have been carried out for several years by the Department of Renewable

Resources on free-ranging polar bears at Cape Churchill. On the assumption that deterrent success would only improve in situations where there was no attractant, after the first year all tests were carried out using baits. The amount of time spent feeding at the bait site did not influence the success of a deterrent. Different deterrents had different rates of success on bears being drawn into or feeding at a bait site (Stenhouse and Cattet 1984). The conclusion after 6 years of research on bear detection and deterrent techniques was that these techniques would be effective in many but not all situations (Stenhouse and Cattet 1984, Clarkson 1987).

From the perspective of reducing aggressive interactions with polar bears, every attempt should be made to prevent the attraction of a polar bear. However, the data show that a bear may still investigate even if no attractants (other than the person) are present. If a bear does approach and there is time, all efforts should be made to deter the bear. But deterrents are not yet foolproof. Until such time as ones of proven efficacy are readily available, the ability to shoot to kill should always be present as a last resort.

Because some bears will not avoid people, this emphasizes the need for everyone travelling in polar bear country to stay alert, exercise caution at all times and expect the unexpected from polar bears.

3.9 Inuit reaction to aggressive polar bears

Because Inuit and polar bears have coexisted together for many years and Inuit recognize the potential danger inherent in an aggressive encounter with a polar bear, we established a research hypothesis that Inuit are more likely to shoot a bear than risk an injurious encounter.

We only examined records of interactions that occurred in the Northwest Territories as few Inuit reside in Manitoba. Inuit were involved in five (28%) of 18 non-injurious aggressive interactions in which the bear left. In contrast, Inuit were involved in 62 percent of the 226 non-injurious aggressive interactions in which the bear was shot. Inuit were involved in five (42%) injurious interactions.

The data, although few, support the hypothesis. In addition, the Inuit that we interviewed said they would never travel in polar bear country without a firearm (App. 2). However, for many years only those incidents in which a bear was killed were reported by Inuit. It should be determined whether more records of non-injurious aggressive interactions of polar bears with Inuit in which the bears leave exist.

3.10 Use of firearms

Presently, firearms may not be carried by visitors to National Parks or National Historic Parks and Sites. However, we felt that this policy might not be applicable to parks containing polar bears and we established the research hypothesis that firearms are necessary for safety when travelling in polar bear country.

None of the victims nor their companions were carrying firearms when they were attacked. During two injurious interactions, we could not determine whether firearms were required to rescue the injured people. In three interactions a bear left on its own initiative after attacking but not killing a human. In one situation, a bear was attempting to pull a man out of a tundra buggy. The bear was hit with an axe until it let go of the man's arm and the bear was unable to continue its attack. Firearms were in close proximity during eight (44%) injurious interactions and were used to rescue the victims before the bears could kill them. No one died when a firearm was available to a witness of a mauling.

Three of the six deaths caused by polar bears may have been prevented if a firearm had been available to the companions of the victims. The presence of firearms definitely prevented an additional nine people from being killed. Although firing warning shots has some deterrent value, carrying a firearm will not always prevent a bear from attacking a person. It could, however, prevent the death of someone who is being mauled by a bear. In addition, if the firearm is a shotgun, it can first be used to deploy deterrents such as cracker shells, plastic bullets or warning shots in the hopes of scaring the bear away before it or a person is injured or killed.

Everyone who was interviewed stressed that they would not travel in areas frequented by polar bears without a firearm (App. 2). Two reasons were given to rationalize their statement: (1) polar bears always present a risk to personal safety; and (2) polar bears live in areas that are remote. When travelling in these areas a firearm not only offers protection from polar bears but can also be used for survival purposes.

Everyone emphasized that firearms should only be carried by someone who knows how to use them. The opinions regarding what was the best firearm to carry varied according to personal preference but pump shotguns were favoured as the easiest to become familiar with and because of their dual function as a deployer of non-injurious deterrents and lethal ammunition. As well, since shotguns, unlike rifles, are close range weapons they would usually be used defensively rather than offensively on polar bears.

Eleven of the 15 wildlife biologists and officers interviewed felt that Parks Canada should change its firearm policy to allow visitors to northern parks inhabited by polar bears to carry firearms, but, they felt that the type and use of the firearms should be strictly controlled. Three biologists did not feel that the policy should be changed. They suggested that visitors should avoid areas where polar bears occur and that if they wished to visit those areas, they should be accompanied by an armed guide who was familiar with behaviour of polar bears. One biologist did not believe the policy should be changed but that park managers should develop strong guidelines to keep polar bears and visitor apart. Specifically mentioned were establishment of fenced, bearproof campsites, proper management of food and of garbage, and minimum group sizes.

We recommend that a person wanting to travel in polar bear country but not experienced with firearms should either hire a trained guide who has experience with both firearms and polar bears or avoid areas inhabited by polar bears. Development of effective, non-injurious deterrents, if and when they become available, would be another alternative.

3.11 Seasonal occurrence of polar bear - human interactions

We analyzed the monthly distribution of injurious and non-injurious aggressive interactions separately for the

Northwest Territories and Manitoba because polar bears are present year-round in the Northwest Territories and in Manitoba essentially only during the ice-free season in Hudson Bay.

In the Northwest Territories, 97 (55%) of 177 non-injurious aggressive interactions in which the bear was shot occurred between August and November (Table 16). This coincides with the ice-free period when the bears are often confined to terrestrial habitats and living off fat reserves. Fewer interactions (27%) occur between April and July when bears are gaining weight in anticipation of the summer fast. This is also breeding time for adult polar bears and when two or three year old cubs begin their life alone. The least number (18%) occur in the cold, dark period between December and March when few people other than polar bear hunters venture out into polar bear habitat.

This pattern is predictable because the probability of interactions depends to a large extent upon number of people and number of bears in any area. As bear density and/or people density increases, so should the number of interactions.

The four different sex and age classes all follow the same annual pattern (Table 16). This is of interest because during the ice-free period, subadult bears are suspected to

Table 16. Seasonal occurrence of injurious and non-injurious aggressive interactions for different sex and age classes of polar bears in the Northwest Territories.

Season	Male		Female	
	Subadult (%) n=70	Adult (%) n=44	Subadult (%) n=22	Adult (%) n=41
August - November	55	52	55	56
December - March	20	18	14	20
April - July	25	30	31	24

have far fewer fat reserves than adults who have much better developed hunting skills (J. Lee, pers. comm.). The proportion of subadults causing problems during the ice-free period could be expected to increase, however, the data do not support this prediction.

We also compared the seasonal distribution of non-injurious aggressive interactions between Inuit and non-Inuit during which the bear was shot. For records in which we could determine the party involved, Inuit accounted for 141 (62%) of such interactions and non-Inuit for 85 (38%) interactions. Inuit reported relatively fewer aggressive encounters between December and March than non-Inuit (Fig. 6). Throughout most of the Northwest Territories, polar bears may be legally hunted between December and April. The relatively fewer number of reported interactions may be because a bear causing a problem at this time is shot and included as part of the quota for the settlement and not reported as a problem bear.

Eleven injurious interactions have occurred in the Northwest Territories. Of these, two occurred between August and November (both injuries), four occurred between December and March (two injuries, two deaths), and two occurred between April and July (both injuries). Three other incidents (two injuries, one death) that involved

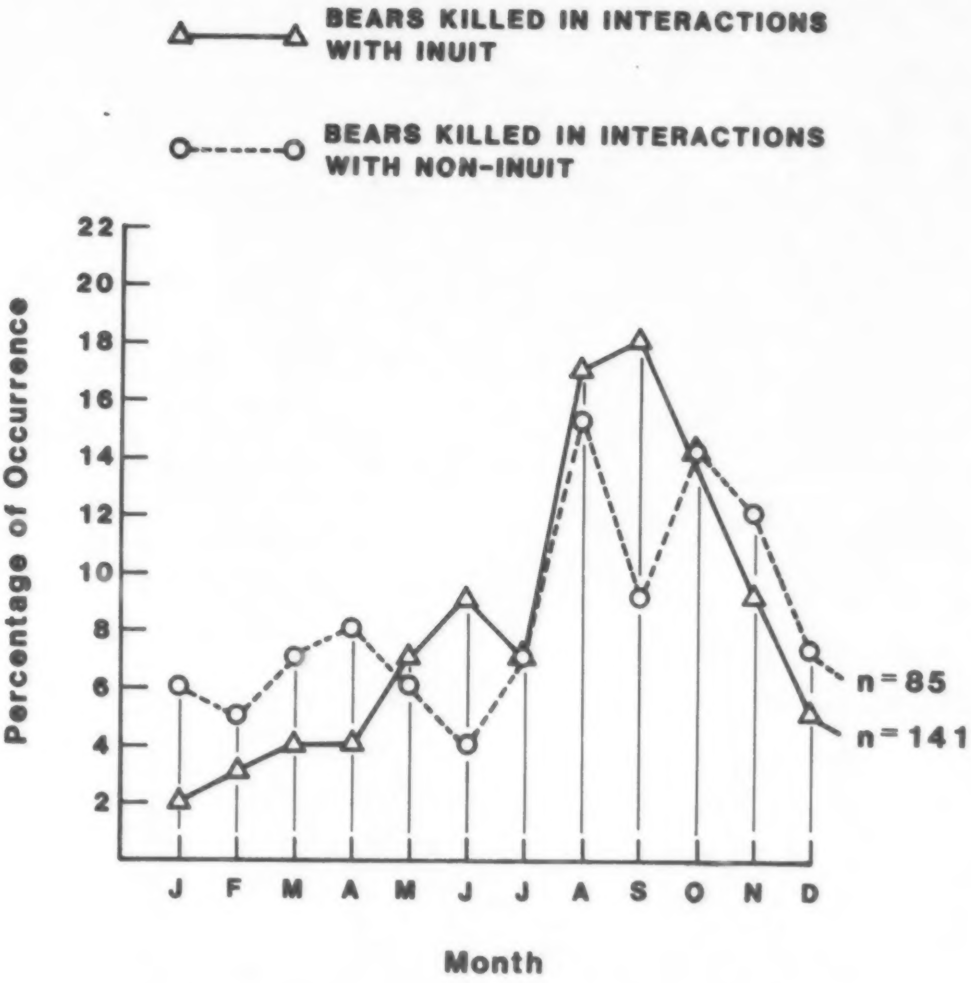

Figure 6. Monthly distribution of aggressive interactions of polar bears with Inuit and non-Inuit in the Northwest Territories.

Inuit took place during the dark season (no specific date was mentioned) and we have assumed that these occurred between December and March also. Although the sample size is small, the seasonal pattern is quite different from non-injurious interactions. No deaths occurred during the ice-free season when bears are fat and hunting activity declines.

Polar bears that frequent the Manitoba coastline during the ice-free season leave Manitoba once the ice forms (Stirling et al. 1977). Only pregnant females stay to den. They remain in the den between November and March. After emerging, they stay on land with their cubs until the ice forms. This greatly influences the seasonal distribution of injurious and non-injurious aggressive interactions.

In Manitoba, 96 (97%) such interactions occurred between July and November. Three (3%) non-injurious aggressive interactions occurred in March. Two involved females with young in the denning area and one was an adult male bear in good condition that was trying to break into a house in Churchill.

The pattern for injurious aggressive interactions is similar. Seven (87%) occurred between July and November and one (13%) occurred in March. Again, the March incident involved a female with young in the Owl River denning area (App. 3).

3.12 Site and location

The site at which injurious and non-injurious aggressive polar bear - human interactions occurred was noted for 366 (98%) records we collected. We separated the analysis for the Northwest Territories and Manitoba because dewline sites, exploration camps, and Inuit hunting camps only occur in the Northwest Territories. In Manitoba, the hunting camp category refers primarily to wilderness camps of non-native goose hunters from Churchill or goose hunting lodges.

In the Northwest Territories, 99 (45%) non-injurious polar bear - human interactions occurred in temporary or permanent Inuit hunting camps (Table 17). The numbers of non-injurious interactions at exploration camps, settlements and on the land were similar (12-15%). In contrast, more injurious interactions occurred at mining or hydrocarbon exploration camps (46%) than in hunting camps (27%). This suggests that Inuit are able to avoid injurious interactions more effectively than are personnel at exploration sites. We suspect that Inuit may be more alert for the potential presence of polar bears.

In Manitoba, the majority (65%) of both injurious and non-injurious incidents occurred within 1 km of Churchill or its satellite communities (Akudlik, Dene Village, Rocket Launch) (Table 17).

The non-injurious interactions in which bears were not killed represent those situations where deterrents were successful, people were able to leave the site, or when a bear left because it was injured during a deterrent attempt but did not die. These results are probably biased for several reasons. First the sample sizes are small. Second, the low number reported for Inuit hunting camps in the Northwest Territories probably occurred because these incidents are rarely reported. There is only a legal requirement to report those incidents during which the bear is killed.

In Manitoba, non-injurious incidents during which the bear is not killed occurred numerous times in Churchill. These were not included in the database because little information was recorded about the bear and about the human involvement during the interaction.

3.13 Time of day

We considered time of day in our interpretation of the data to determine whether this related to the daily activity pattern of polar bears. Time of day that an aggressive interaction between a polar bear and a human occurred was recorded for 165 (44%) of all records collected. We divided

Table 17. Location of injurious and non-injurious aggressive interactions between polar bears and humans in the Northwest Territories (NWT) and Manitoba between 1966 and 1985.

Location	Injurious interactions		Non-injurious interactions			
			Bears were killed		Bears or humans left	
	NWT (%) n=11	Manitoba (%) n=8	NWT (%) n=220	Manitoba (%) n=95	NWT (%) n=23	Manitoba (%) n=9
settlements	9	63	13	65	17	*
temporary or permanent hunting camps	18	-	45	12	9	11
mining or oil exploration camps	46	+	15	+	13	+
on the land (sea ice, tundra, beach, etc.)	27	37	12	14	26	44
temporary or permanent research camps	-	-	9	4	26	45
dewline sites and weather stations	-	+	6	+	9	+
recreational cabins	+	-	+	5	+	-

* this happens innumerable times in Churchill but these were not included in the data base

+ these location types do not occur

a 24 hour day into four 6 hour time periods -- midnight to6 am; 6 am to noon; noon to 6 pm; and 6 pm to midnight.

We found that more injurious and non-injurious aggressive interactions (44%) occurred between midnight and 6 am than any other time period (Table 18). This pattern is similar to results of the only study to date on daily polar bear activity patterns in which polar bears were observed to be most active between midnight and 8 am (Stirling 1974).

These results have important implications for people travelling in polar bear country. Not only is it frequently dark between midnight and 6 am (except during summer) but most people will be asleep, making it difficult to maintain a watch for polar bears at a time when they are likely to appear. For that reason, a system that could alert people to an approaching bear should be considered when planning a trip or a camp. A simple, portable tripwire alarm has been developed for small mobile field camps (Stenhouse 1983). Another alternative is to confine people to buildings that are bear-proof during times when visibility is reduced and bears are likely to be more active.

Table 18. Time of day that injurious and non-injurious aggressive interactions occurred.

Time	Injurious interaction (%) n=12	Non-injurious interaction Bear killed (%) n=163	Bear left (%) n=10
midnight-6 am	42	44	40
6 am-noon	17	14	10
noon-6 pm	24	16	20
6 pm-midnight	17	26	30

4. CONCLUSIONS

4.1 A descriptive model of polar bear - human interactions

Unless specifically stated to be otherwise, this descriptive model of polar bear - human interactions characterizes all situations we analyzed. We cannot overemphasize that most polar bears appear to be very tolerant of humans and will steer clear of them. This was stressed by everyone we interviewed. The other point consistently underlined was the individual nature of polar bears. What one bear will do, another may not. The Boy Scout motto is good advice. Always be prepared.

4.1.1 Season

In the Northwest Territories, conflicts can occur at any time of year but there is a definite peak for non-injurious aggressive interactions between July and November. However, more injurious interactions occur between December and March. We speculate that this may be related to reduced visibility due to long hours of darkness and inclement weather and the fact that bears are active hunters and at their leanest body weight.

In Manitoba, almost all interactions only occur between August and November when bears are stranded on shore until ice reforms in Hudson Bay. In the Owl River denning areas, females with young remain in dens from November till about March. A few interactions have occurred once females emerge from dens with their new cubs.

4.1.2 Location

In the Northwest Territories, more non-injurious incidents occur at hunting camps, probably because of the ample supplies of carcasses that attract bears. However, relatively more people have been hurt or injured at hydrocarbon exploration camps.

In Manitoba, most incidents occur in or near Churchill and its satellite settlements, probably because a high density of humans overlaps with a high density of bears. However, conflicts can occur anywhere even when densities of bears and humans are low.

4.1.3 Time of day

Conflicts can occur at any time during the day or night, however, there is a definite peak between midnight and 06:00 This is probably because bears are more active at this time of day and so are most likely to discover a camp and to investigate. Between midnight and 06:00, people are most likely to be in camp but in a tent or cabin, out of sight of an approaching bear.

4.1.4 Attractants

More injurious interactions occur when there are no attractants (other than the victim). This suggests that sometimes the person is the attractant. We feel this may be true when the aggressor is a single (usually male) polar bear, however, if the aggressor is a female polar bear with cubs, we believe that she responds to the human as a threat to her cubs and not as an attractant.

Most non-injurious aggressive interactions occur when other potential attractants besides humans are present. In these situations, we feel that the presence of other attractants probably draws a bear into a site. When a bear and human then confront each other, an aggressive interaction can occur.

4.1.5 Sex, age, and condition of the bear

In both the Northwest Territories and Manitoba, subadult males are the most likely sex and age class to become involved in non-injurious interactions. The second most likely group differs between the two areas: adult males or females in the Northwest Territories; and subadult females in Manitoba.

However, a person has a slightly higher risk of being injured or killed in the Northwest Territories if the aggressive bear is an adult male or adult female with cubs; and, in Manitoba if the aggressive bear is a subadult or adult male.

Although bears in good physical condition are also involved in aggressive interactions, a bear in poor condition is more likely to cause problems than a bear in good condition.

4.1.6 Motive of the bear

There are different motives for injurious and non-injurious aggressive interactions. For black or grizzly bears these have been described as sudden encounters, predaceous attacks, aggressive interactions related to availability of food or garbage, provoked attacks, and aggression without injury (Herrero 1985).

We believe that all these types of aggressive interactions also occur between polar bears and humans. The injurious interactions that we called sudden encounters were all related to females with cubs that are suddenly confronted by a human. The female responds to the human in an aggressive manner because she views the human as a threat to her cubs.

The characteristics of a predaceous attack were seen in most of the injurious attacks by male polar bears and also by one subadult female.

By far the majority of non-injurious aggressive interactions with polar bears are due to the presence of attractants such as animal carcasses, food and/or garbage.

Examples of provoked attacks by polar bears were few. Most polar bears when injured by a bullet retreated. Only three responded aggressively. As well, two bears attacked while emerging from drugging and handling. Both were productive females that probably perceived the humans as threats to their cubs.

We do not know how frequently aggression without injury occurs because the bear was killed during most interactions before it could injure a person. In some situations, a bear was shot to protect property, but at other times, it was self defense. The few records of non-injurious interactions where a bear left were probably a result of use of deterrents. In addition, reports of this type of interaction are rarely recorded.

4.1.7 Activity of a human prior to a conflict

One half of non-injurious aggressive interactions occur when a person is asleep or inside a dwelling. Most other interactions occur when a person is engaged in some activity outside and not aware of an approaching bear.

The injurious aggressive interactions also appear to occur when a person is not aware of an approaching bear. However, in some of these situations, the bear appears to be acting in a predatory manner and attempts to remain concealed until it can attack. In other situations, a person and a bear are unaware of each other until they are quite close. If the bear is a female with her cubs then an injurious interaction can result. One person was injured when a bear was in a settlement (probably because it was attracted by food or garbage) and the bear attacked when it saw a person.

4.1.8 Behaviour of an approaching bear

Bears do have some very obvious behavioural responses that imply curiosity, agitation or predation. When a polar bear is approaching, its behaviour must be closely monitored to determine its mood. Any of the following behaviours suggest a curious polar bear -- standing usually on all four feet and moving slowly, stopping frequently to sniff the air, holding its head high with ears forward or sticking out and moving its head around to catch a scent. Like other bear species or a dog, a polar bear will often circle downwind and approach from that direction to catch the scent of the object of interest. This is often initiated from quite a distance (150+ m).

An agitated polar bear has different behaviours. They include a loud huffing sound, snapping its jaw to make loud sounds, staring directly at the person, and/or lowering its head below shoulder level with ears back and pressed against the side of its head. The head may be swaying back and forth sideways. Sometimes they may stamp their feet. Bluff charges have rarely been observed in polar bears. A charging polar bear should be interpreted as a bear intent on injuring a person.

A bear that is hunting employs two main behaviour patterns. If still hunting, it sits beside a seal hole, remaining motionless for often an hour or more, until the seal emerges and it can attack. The other pattern used is a stalk during which the bear attempts to remain concealed from its intended prey, until it can make a final rush and pounce. Once it captures its prey, a polar bear bites its victim several times on the back of the head and neck to kill the victim.

A bear that approaches and does not show classic signs of curiosity should cause people to be prepared for the worst.

4.1.9 Preparation to avoid potential conflicts

Preparations to avoid potential conflicts with polar bears focus on five main areas -- alertness, avoidance, attractants, detection and deterrents.

People travelling in polar bear country should always be alert to the possibility of an encounter with a polar bear.

Potential for an aggressive interaction with a polar bear can be reduced by avoiding areas where polar bears concentrate. These include such areas as maternal denning areas, summer retreats, and fall staging sites (where bears concentrate to wait for ice to form). Campsites on points of land, along the shore, near pressure ridges and other such habitats that attract polar bears should be avoided.

Polar bears, like all other bear species, are attracted to food sources. Potential attractants such as food, animal carcasses, and garbage should be well away from sleeping and living quarters. Dogs are also potential attractants and should be staked far enough away to provide warning of an approaching bear but close enough that their warning can be heard.

The ability to detect an approaching bear from a distance (200+ m) allows a person time to determine what to do. It is advisable to anticipate a potential aggressive interaction and to formulate several action plans so that the best response can be chosen during an actual interaction. Different kinds of detection devices are available for different situations. Deterrents can then be deployed at the earliest possible moment.

Several deaths and injuries could have been prevented if people were carrying deterrents and firearms. However, these are only as effective as the person's ability to use them. Some deterrents are more successful than others. Research to improve the efficieny of deterrents is ongoing and an effort should be made to determine the best deterrent available for a particular human camp or activity.

If people are prepared and are able to detect a bear when it is at least 150 m distant, there is ample time to deploy deterrents. Deterrents may be effective in dissuading a bear from coming closer. If possible, deterrents should always be used first. As a last resort, firearms are a necessity. Again, it is important that the person knows how and when to use their particular firearm.

If in the future, deterrents are developed and tested that are almost 100 percent effective in repelling all types of approaching polar bears then and only then, could such deterrents replace firearms. Such a development would be particularly relevant to park managers.

It is a wise idea to never travel alone so that if one person is attacked, the other can attempt to save him.

4.1.10 Behaviour of a person during an aggressive interaction

An approaching polar bear should always be watched and its behaviour should be monitored to determine a person's response. If possible, a person should try to leave. If not, and there is time, available deterrents should be dispensed.

Different responses have been suggested for different types of attacks by black and grizzly bears (Herrero 1985). These are based on the most successful approach but will not always work in all situations. Because of certain similarities between the types of attacks displayed by polar bears to those observed in black and grizzly bears, we also recommend different responses.

If a person suddenly encounters at close range a female polar bear with her cubs and the female charges, we recommend that a person play dead if they feel attack is imminent. The body position should minimize exposure of vital areas. The junior author (Herrero 1985) recommends the "...position of hands behind the neck, fingers interlocked, with the forearms and elbows protecting the face as best as possible...knees should be drawn up in the fetal position ...(or) lying flat on the ground, face down...(and) pack on (your back)." The female bear probably views the person as a threat to her cubs and once the threat is immobilized, she will collect her cubs and leave. A person should remain passive until the bears are gone.

If a person is attacked by a single bear and they suspect the motive is predation, we recommend that a person try to get away or to act aggressively towards the bear. The odds are against an unarmed person, however, fighting may add valuable time for someone nearby to kill the bear.

5. RECOMMENDATIONS

5.1 For managers of bears and/or parks

We present the following recommendations as options that park and wildlife managers may consider to conserve polar bears and to protect visitors. Although they were developed specifically in response to terms of reference that we received from Parks Canada, the recommendations are equally applicable to any person whose aim is to reduce polar bear - human interactions and whose responsibilities include conserving polar bears and/or protecting people that live, travel, or work in the Arctic.

To derive the recommendations, we considered the results of our analysis and determined the best actions to reduce potential aggressive interactions with polar bears. Many actions were suggested during interviews with polar bear biologists and hunters or in published and unpublished literature.

(1) Visitors to parks should be allowed to carry firearms under the following conditions:

  (a) A park permit is required to carry one;

  (b) Firearms are sealed by a park warden. The seal must be easily broken and allow a loaded firearm to be carried;

  (c) A fine is levied for a broken seal. The amount should be enough to make a person think twice about shooting without good reason;

  (d) The applicant's skill with firearms must somehow be evaluated and a certificate from a firearm safety course may be requested;

  (e) The size and type of allowable firearm should be specified (eg. 12 gauge pump shotgun that can carry five shells; no handguns); and

  (f) The requirements of the policy must be well advertised to the visiting public.

(2) Recommendation (1) can be removed when non-injurious deterrents, that are readily available, are scientifically demonstrated to be effective in repelling aggressive polar bears.

(3) If visitors cannot carry firearms or they are not experienced with firearms, they should be advised to hire a guide who has experience with firearms and also is familiar with polar bear behaviour and ecology. Only qualified guides should be allowed to offer these services. Parks Canada may desire to establish a certification course for guides similar to that used to qualify instructors by the Department of Renewable Resources for their Bear Safety Courses. Parks Canada may also offer the service of trained guides such as is offered at the Historic Park and Sites in Churchill, Manitoba or as was done on a one time basis in Auyuittuq when visitors were threatened by polar bears.

(4) Parks Canada should either make ammunition and different types of deterrents available to their visitors on a rental or sign-out basis or ensure that these items can be purchased in the closest communities. These items can be difficult to transport because of their status as "Dangerous Goods." The Department of Natural Resources in Churchill, Manitoba will hand out cracker shells to the travelling public after they have signed a release form absolving the Department of any responsibility.

Parks Canada should ensure that any person carrying deterrents knows how to use them effectively.

(5) Rather than allow firearms, Parks Canada could close to the travelling public areas of the park where polar bears have been observed or are expected to concentrate seasonally (e.g. summer retreat). This practice is used in certain circumstances in some southern parks. Areas would need to be patrolled regularly so that they are closed as soon as bears are observed and that closures need not be longer than necessary. Closed areas must be clearly posted. Because polar bears are so mobile, this may not be very effective. This is obviously impractical at the very small Churchill National Historic Park and Sites.

(6) All park development including buildings, shelters, trails, suggested travel routes, etc. should be preceded by an analysis of polar bear habitat use of the proposed development area. Wherever possible, permanent buildings and shelters should not be constructed near areas that may be frequented by polar bears such as beaches, points of land, denning areas, etc. In the Arctic, Inuit polar bear hunters that are familiar with movements of polar bears could be consulted to identify such areas.

(7) Parks Canada may wish to develop a bear-proof enclosure that would be mandatory for visitors to sleep in when visiting areas where polar bears hang out. These could be constructed at reasonable intervals along visitor travel routes. Existing emergency shelters in Auyuittuq National Park should also be made as bearproof as possible.

(8) A pack in - pack out policy should apply to food and garbage. Garbage pickup must be at regular intervals. Polar bears have been attracted to garbage left at emergency shelters in Auyuittuq on several occasions. Parks Canada may wish to consider testing the use of bearproof containers developed by Denali National Park staff in Alaska for backpackers to determine if the containers are also polar bear proof.

(9) Parks Canada may wish to offer a short session on safety and polar bear ecology to arriving visitors who intend to travel without a guide. At the very least, they should make literature available to anyone making inquiries or arriving at a park. Brochures can be modelled after the pamphlets developed by the Department of Renewable Resources and should be specific to polar bears. The brochures should be available in languages used most frequently by visitors.

(10) Rules invoked by Parks Canada should be flexible enough to accommodate the different types of visitors expected.

(11) The rate of aggressive interactions with polar bears should be monitored and any incident should be investigated thoroughly. Data required to evaluate an incident are presented in Appendix 5.

5.2 For people intending to travel in the Arctic

(1) Learn about the habits of polar bears and how to reduce the potential for interactions. Information is available from the Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, NWT, from the Department of Natural Resources, Government of Manitoba, Churchill, Manitoba, from Parks Canada, and from this report.

(2) Carry a firearm only if you know how to use one, when to use one, and have secured all necessary permits and/or licences. Otherwise, hire a guide who has experience with firearms and with polar bears or else avoid visiting areas inhabited by polar bears. Do not split up groups especially when a polar bear is sighted.

(3) Always be alert for polar bears. Try not to travel when visibility is poor and be aware of seasonal preference of terrain by polar bears. Check in with the nearest park warden or wildlife officer to determine where polar bears have been seen or are most likely to be. Know where not to camp and where not to travel.

(4) Carry and set up a portable tripwire alarm system around your tent when retiring in the evening (Stenhouse 1983). Otherwise set up some other warning device such as a pack tied to a stove so that you can be warned when you are asleep. You may wish to take a dog, but only one that has proven experience with polar bears will be reliable for warning or deterrence. It may be possible to make arrangements with residents of northern settlements to rent such dogs. This is only advisable if you can accommodate a dog into your plans and are familiar with how to handle one. Be prepared to lose the dog. Keep the dog staked so that it cannot run to you for protection. If you have none of these options available to you and polar bears are anticipated to be in the vicinity of your camp, maintain a night watch.

(5) Carry deterrents and know how and when to use them. Be sure they will be available on arrival if you are

not able to purchase them before you leave your home. Check with park wardens or wildlife officers to see which deterrents are recommended.

(6) Consider taking along an HF radio so that you have a chance of making contact if an emergency arises. In the north where everything is remote, this is a good idea even if bears may not be around.

(7) Have windows in your tent so that you can look out if you suspect a polar bear is nearby. If there are several tents, maintain at least 5 m between them so that if a bear is caught in camp, it will have an avenue of escape.

(8) Keep food and garbage in bearproof containers. Some have been specifically developed for the backpacker in Denali National Park, Alaska. However, these have not been tested to see if they are polar bear proof.

PERSONAL COMMUNICATIONS

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Billenduke, Shelley. Acting Superintendent. Manitoba North, National Historic Sites of Parks Canada, Environment Canada. Winnipeg, Manitoba.

Clarkson, Peter. Grizzly Bear and Wolf Biologist. Department of Renewable Resources, Government of the Northwest Territories. Inuvik, Northwest Territories.

Cook, Bill. Wildlife Biologist. Resource Management Division, Great Smoky Mountains National Park. Gatlinburg, Tennessee.

Elliot, Tom. Chief Park Warden, Auyuittuq National Park, Parks Canada, Pangnirtung, Northwest Territories.

Gamble, Bob. Northern Parks Establishment, Parks Canada, Environment Canada. Yellowknife, Northwest Territories.

Hines, Jim. Wildlife Ecologist. Department of Renewable Resources, Government of the Northwest Territories. Yellowknife, Northwest Territories.

Hoppe, Mark. Renewable Resources Officer. Department of Renewable Resources, Government of the Northwest Territories. Pangnirtung, Northwest Territories.

Jonkel, Chuck. Professor. University of Montana. Missoula, Montana.

Lunn, Nick. 83 Patricia Crescent, Edmonton, Alberta.

Kearney, Steve. Regional Biologist. Department of Natural Resources, Government of Manitoba. Thompson, Manitoba.

Langevin, Ed. 13431 - 71st St. Edmonton, Alberta.

Lee, John. Polar Bear Technician. Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, Northwest Territories.

Leonard, Richard. Wildlife Management Officer, Environment Canada, Parks, Prairie and Northern Region, Winnipeg, Manitoba.

Russell, Dick. Canadian Wildlife Service, Environment Canada. Ottawa, Ontario.

Schweinsburg, Ray. 34 Tamarack Drive, Whitehorse, Yukon Territory.

Smith, Barney. Bear Biologist. Department of Renewable Resources, Government of the Yukon. Whitehorse, Yukon Territory.

Stenhouse, Gordon. Regional Biologist, Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, Northwest Territories.

Stirling, Ian. Research Scientist. Canadian Wildlife Service, Department of Environment. Edmonton, Alberta.

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Appendix 1. Use of established and proposed Canadian national parks, historic sites, and park reserves by polar bears and man

Figures displaying important polar bear habitat in the vicinity of Thompson River park reserve (Banks Island), Bjorne Peninsula park reserve (Ellesmere Island), Pond Inlet park reserve (Baffin Island), Auyuittuq National Park (Baffin Island), and Wager Bay park reserve (Keewatin district) are included.

No figures are presented for Northern Yukon National Park and the Northern Ellesemere Island park reserve because few polar bears use these areas. No figures are presented for the Churchill and York Factory National Historic Park and Sites, and the Owl River park reserve because polar bear habitat use of these areas is well documented.

A. Established national parks and reserves

1. Northern Yukon National Park - Along the Beaufort Sea coastline, polar bears are seasonal visitors. Several pregnant females den on Herschell Island every year (S. Amstrup, pers. comm.). Very rarely do polar bears remain along the coastline after the ice has melted. Most, if not all, bears follow the retreating pack ice north (Stirling et al. 1981). An estimated 1,400 polar bears form the Canadian portion of the Beaufort Sea population (Stirling et al. 1987).

   Polar bears are hunted along the Beaufort Sea coastline between 1 December and 31 May by hunters from Aklavik, Inuvik, and Tuktoyaktuk.

   This park has no road access. The majority of visitors arrive by floatplane during the ice-free season. No conflicts between visitors and polar bears have occurred (B. Smith, pers. comm.). Most visits include overnight use of the park.

2. Auyuittuq National Park - Pregnant females occupy maternity dens in the park every winter. Polar bear tracks are found or family groups have been sighted in almost every park fiord along Davis Strait during snowmobile and helicopter surveys conducted by Parks Canada in April and May (J. Hines pers. comm.)(Fig. 1). Other sex and age groups appear to concentrate offshore along the floe edge. Family groups join these bears during June and July. Throughout break-up and the open water season, polar bears may be seen in the park scattered along the shores of the fiords entering Davis

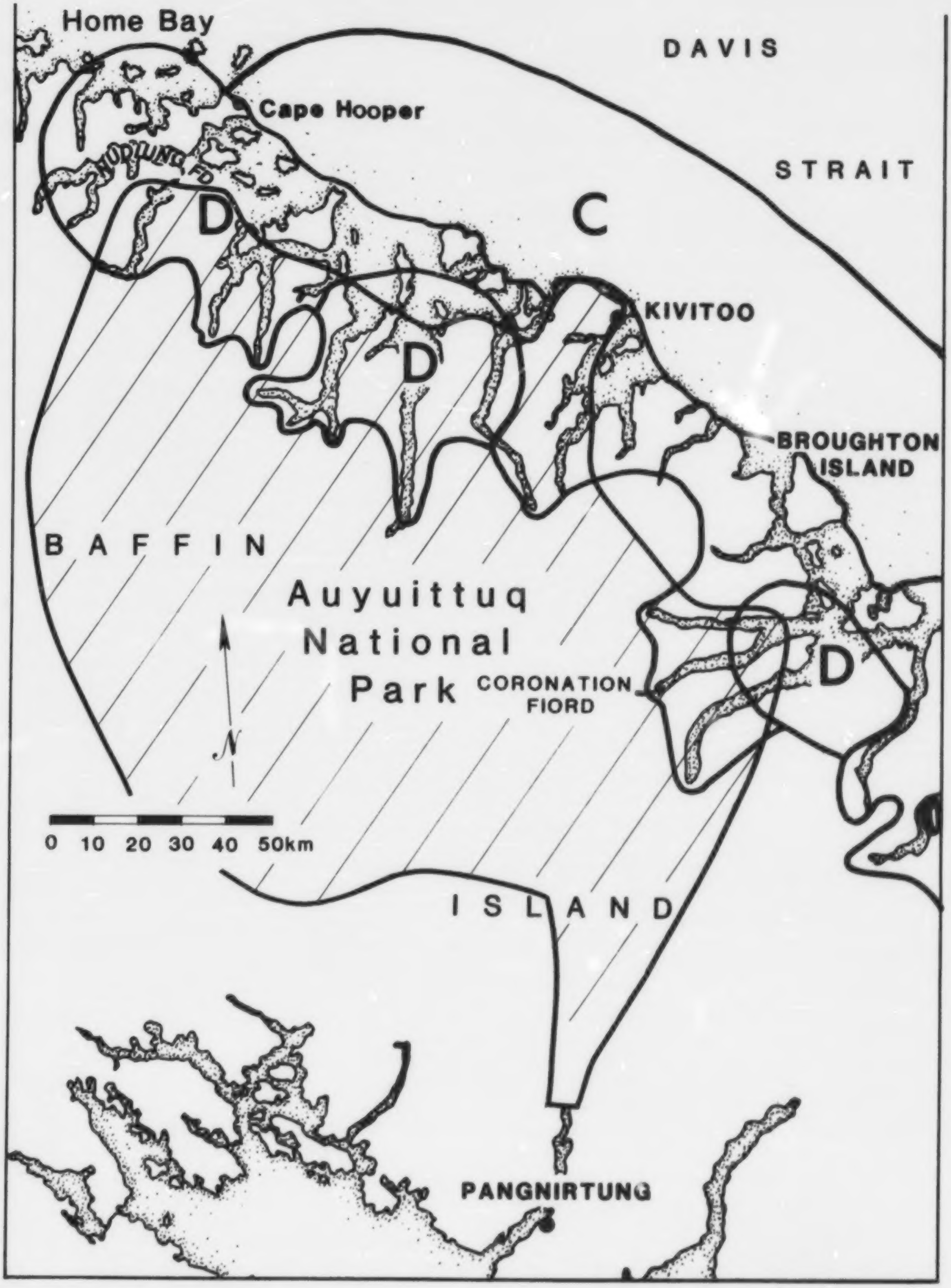
Home Bay
DAVIS
STRAIT
Cape Hooper
HORJUNG FD
D
C
KIVITOO
D
BROUGHTON ISLAND
BAFFIN
Auyuittuq National Park
CORONATION FIORD
D
N
0 10 20 30 40 50km
ISLAND
PANGNIRTUNG

Figure 1. Winter concentration (C) and denning (D) areas used by polar bears near Auyuittuq National Park.

Strait (R. Breneman 1985a). Occasionally, the bears travel inland. The sex and age classes of bears using these summer retreats are unknown. Every year, a number of bears tend to concentrate in the vicinity of Broughton Island during September and October while waiting for new ice to form (M. Hoppe, pers. comm.). The latest estimates of population size have indicated that polar bears are being overharvested and hunters from Broughton Island and Clyde River have reduced their harvest by 50 percent (Lloyd 1986).

Inuit from Pangnirtung, Broughton Island, and Clyde River hunt polar bears along the offshore ice between 1 December and 31 May. During spring and summer, they camp, fish, hunt, and pick berries along the fiords entering Davis Strait (R. Breneman 1985b).

Auyuittuq is not accessible by road. Visitors reach the park by boat during the ice-free season or by snowmobile during winter. Over 90 percent of the 300 tourists who visit the park each year during July and August usually hike in the Pangnirtung Pass area. Less than 30 visitors each year travel in the sections of the park adjacent to Davis Strait each year. Visitors to that portion of the park usually comprise one or two groups of skiers during April and May and several hiking or climbing groups between June and August (R. Breneman 1985b). Virtually all visits include overnight use of the park.

Five aggressive interactions have occurred between polar bears and humans. In 1979, a park warden shot a polar bear that was attempting to break into the Hunters' and Trappers' cabin at Kivitoo. There was seal meat cached outside the cabin. In 1981, a family group of polar bears followed two skiers up one of the fiords for some distance. The skiers lost the bears by skiing unroped through a crevasse field. It is not clear whether the bears acted aggressively towards the skiers, however, the skiers were very distressed by the interaction. In 1982, a female accompanied by yearling cubs attempted to break into one of the park emergency shelters. The hikers inside called for help on the radio and two armed Inuit were dispatched to the site to chase the bears away and to escort the visitors out. In 1987, a subadult male bear was shot at Kivitoo after it acted aggressively towards two park wardens staying at the cabin. Again, seal meat was present. Dogs staked nearby barked at the approaching bear (T. Elliot pers. comm.). Also in 1987, an adult male polar bear was seen near a temporary Inuit camping site. The group of six

Inuit were gathering berries. The bear walked towards the tent. Several warning shots were fired. The bear ran away and was found dead nearby in the morning (T. Elliot pers. comm.).

3. National Historic Park and Sites at Churchill (Prince of Wales, Cape Merry, and Sloop's Cove) - While there is ice on Hudson Bay, polar bears do not frequent these sites. As the ice melts in July, polar bears of both sexes and all ages come ashore. Females with young tend to move inland to the denning area while adult and subadult males concentrate along the coast. Between 1981 and 1984, 75 percent of 142 polar bear sightings at these sites occurred between mid-July and mid-August (R. Leonard 1985). The polar bears seen in this area belong to the population that frequents the Manitoba coastline during the ice-free season, den in the Owl River area of Manitoba, and spend winter on Hudson Bay where they are hunted by Inuit from Rankin Inlet, Eskimo Point, Whale Cove, and Chesterfield Inlet. Population studies of this population have been virtually continuous since 1965. Approximately 1000 polar bears reside in this area (Urquhart and Schweinsburg 1984).

   Cape Merry is accessible by road from Churchill while Fort Prince of Wales and Sloop's Cove are on the west side of the Churchill River and can only be reached by boat. Two to four thousand people visit each site annually during the ice-free season (S. Billenduke, pers. comm.). Visits are confined to daylight hours and visitors are accompanied by Parks Canada staff carrying firearms. Staff actively deter any polar bear that approaches these sites during visiting hours and this has prevented any aggressive interactions between visitors and bears. However, in the immediate vicinity where it is not possible to detect and deter all polar bears (i.e. Churchill), over 100 aggressive interactions between polar bears and humans have occurred since 1967; two people died, seven people were injured, and over 100 bears have been shot.

4. York Factory National Historic Site - Use of this area by polar bears is similar to that described for the previous sites. Unlike the Churchill area, polar bears do not stage here while waiting for the ice to form. Instead they move through this area throughout the icefree season (S. Kearney, pers. comm.). The polar bears that use this area belong to the same population as those using the Churchill sites.

York Factory has no road access. Less than 100 people visit each year. Most parties arrive after having paddled down the Hayes River. Some also come to this area to hunt waterfowl and moose every year. All visits include overnight use (S. Billenduke, pers. comm.).

At least four aggressive interactions between polar bears and humans have occurred here. One male bear, which had been used in physiological experiments the previous fall, was shot in 1975 because he was attemping to enter a trapper's cabin. In 1985, a male bear was shot at Silver Goose Lodge which is about 1.5 km from York Factory. A second bear was shot there in 1986 after he charged a caretaker and his son. That bear had been tagged at the Churchill dump in 1985. The fourth bear (1985) approached several people and followed them as they retreated. The bear eventually left after shots were fired at it.

B. Proposed park reserves

Should any of these areas become national parks, it is expected that park visitation will be low (equal or less than the annual number of visitors to Auyuittuq National Park). Visitors will probably only arrive during the ice-free season. Access will be limited to boat or floatplane. Park facilities will probably be limited to park ranger cabins that may only be seasonally occupied (B. Gamble, pers. comm.)

1. Thompson River area, Banks Island - No published data on the documented use of this area by polar bears exist. Some pregnant females occupy dens in this area each year (I. Stirling, pers. comm.) (Fig. 2). The occasional bear may spend the ice-free season here (R. Russell, pers. comm.). The sea ice in this area is predominantly multi-year ice which is not preferred ringed seal habitat (Kingsley et al. 1985). No estimate of population size exists.

   Inuit hunters rarely come to this area to hunt bears (J. Lee, pers. comm.). No aggressive polar bear - human interactions have been reported from this area.

2. Bjorne Peninsula, Ellesmere Island - Few data on the use of this area by polar bears exist. Maternity denning is suspected and the western coastline may be used by bears during the ice-free season (Fig. 3). Chunks of multi-year ice often remain all summer in the waters of Norwegian Bay between Graham Island and Bjorne Peninsula. Some polar bears are suspected to follow the

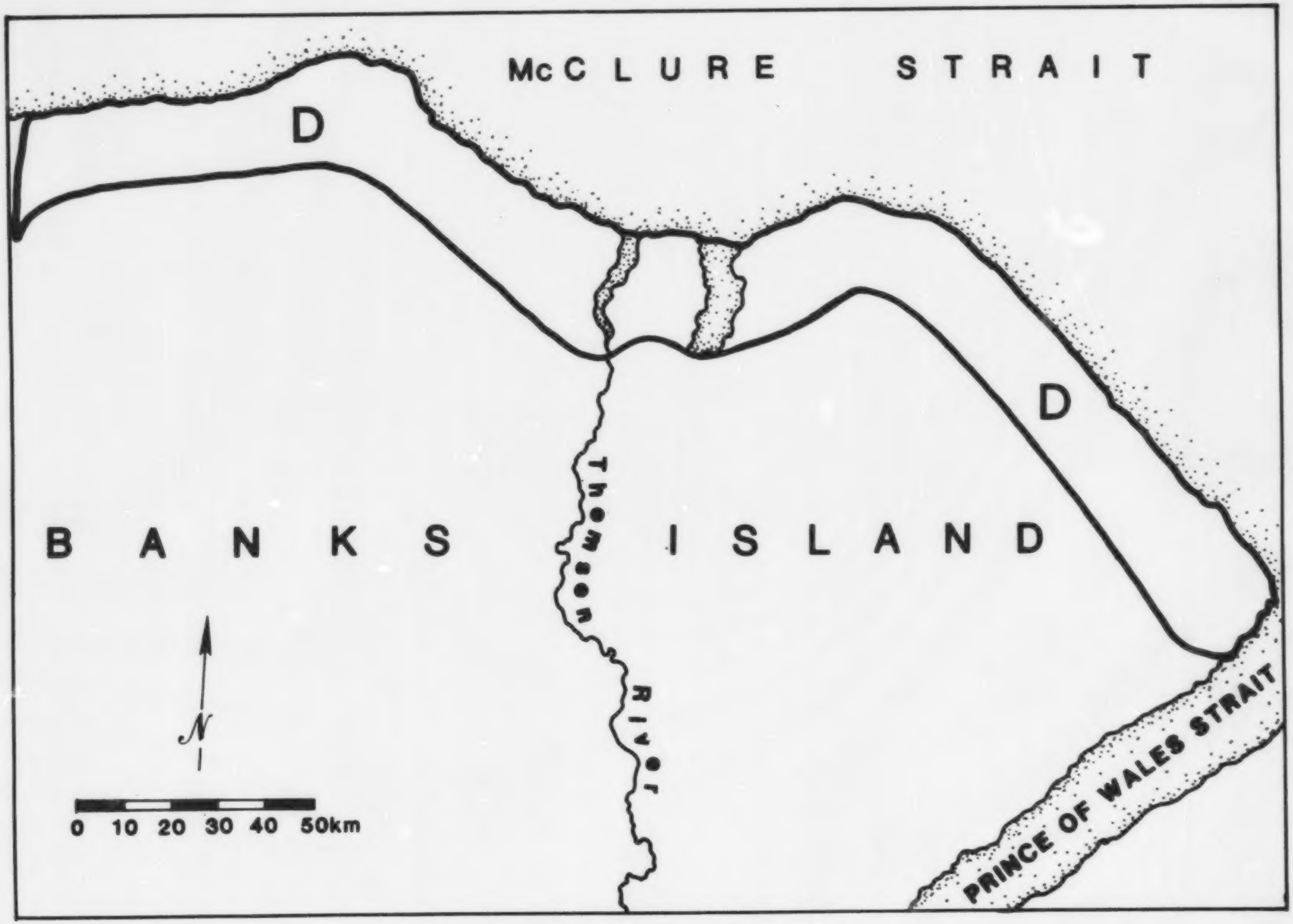
McCLURE STRAIT
D
D
BANKS ISLAND
Thomsen River
N
0 10 20 30 40 50km
PRINCE OF WALES STRAIT

Figure 2. Denning (D) areas used polar bears near the proposed park reserve for northern Banks Island.

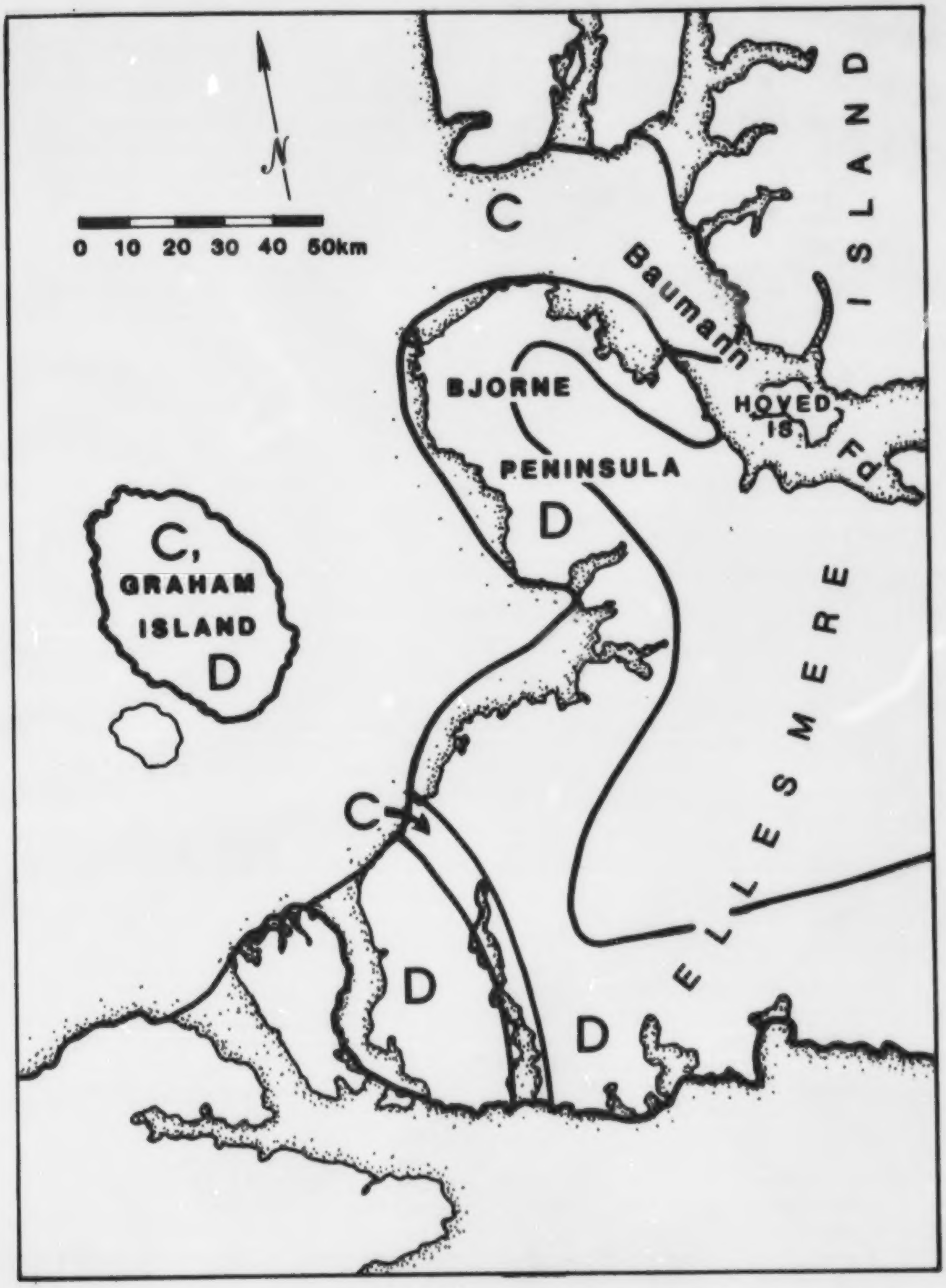
N
0 10 20 30 40 50km
C
Baumann Fd
ISLAND
BJORNE
PENINSULA
HOVED IS
C, GRAHAM ISLAND D
D
C
D
D
ELLESMERE

Figure 3. Winter concentration (C) and denning (D) areas used by polar bears near the proposed park reserve for Bjorne Peninsula, Ellesmere Island.

ice to this area from Belcher Channel and Jones Sound (I. Stirling, pers. comm). The density of polar bears is thought to be low because of the low density of ringed seals (Kingsley et al. 1985). The bears in this area are thought to be part of the population of bears that inhabit Barrow Strait. The population estimate of 1,700 bears for this whole area that was derived from studies in 1977 is thought to be low (Urquhart and Schweinsburg 1984).

Approximately, one quarter of Grise Fiord's polar bear quota is killed in Norwegian Bay each year (Stirling et al. 1984). The hunting season extends between 1 October and 31 May.

One bear was killed here during an aggressive non-injurious interaction at a geological exploration camp in 1976.

3. Northern Ellesmere Island - No data for use of this area by polar bears exist. Multi-year ice occurs here almost year-round and seal density is low. Polar bears do occur here but density is suspected to be very low (C. Jonkel, pers. comm.).

   No polar bear hunting occurs here.

   In spite of the low density of bears, one was killed in self defense by a Japanese explorer travelling to the north pole in 1978.

4. Pond Inlet area, north Baffin - Pregnant females occupy dens on the north and east coasts of Bylot Island. Polar bears (especially family groups, adult females and subadults of both sexes) use those same areas and also the coastline from Pond Inlet east and south to Buchan Gulf during the ice-free season (Fig. 4). After the ice forms, all polar bears (except perhaps pregnant females) travel to the floe edge to hunt seals (Schweinsburg et al. 1977). These polar bears belong to the Eastern Lancaster Sound subpopulation which has been estimated to contain at least 2,200 polar bears (Urquhart and Schweinsburg 1984).

   Hunters from Pond Inlet kill polar bears throughout Eclipse Sound and Pond Inlet between 1 December and 31 May (Schweinsburg et al. 1977). During the ice-free season, summer camps are scattered along the shorelines.

   At least six bears have been killed in defense of life or property in the last ten years. Reports of polar

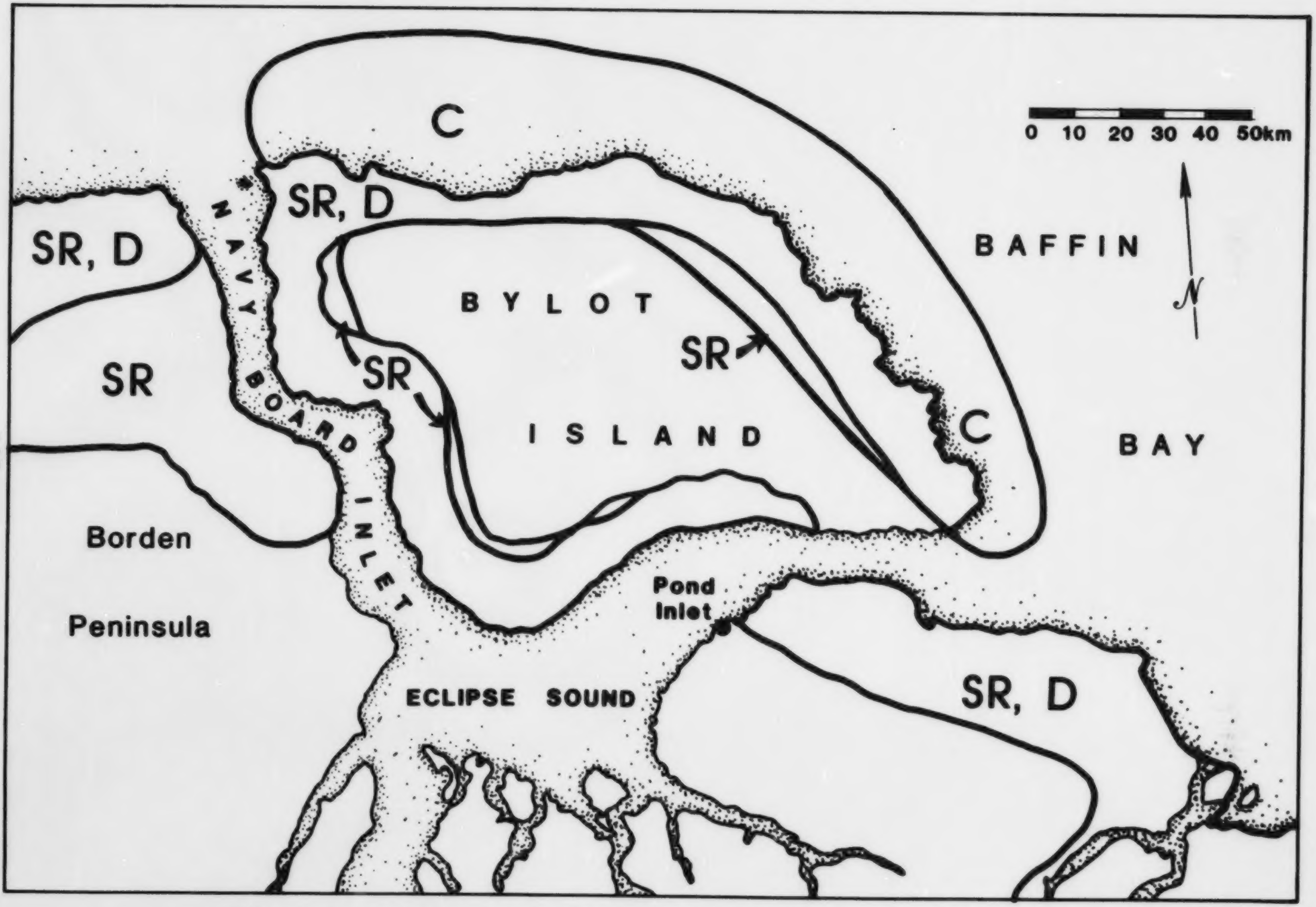
C
0 10 20 30 40 50km
SR, D
SR, D
NAVY BOARD INLET
BAFFIN
BYLOT
SR
SR
SR
ISLAND
C
BAY
Borden
Peninsula
Pond Inlet
ECLIPSE SOUND
SR, D

Figure 4. Winter concentration (C), denning (D), and summer retreat (SR) areas used by polar bears near the proposed park reserve for Pond Inlet, Baffin I.

bears robbing meat caches during the ice free season increased in the last two years (J. Lee, pers. comm.).

5. Wager Bay - A denning area for pregnant females extends from the south shore of Wager Bay to at least 10 km inland. The shores of Wager Bay are a popular summer retreat for polar bears partially because seal density during summer is relatively high (Heard and Donaldson 1981) (Fig. 5). During one survey, 48 bears were counted. Most occurred between Reversing Falls and Paliak Islands on the south shore. Bears were also observed on islands along the north shore. No polar bears were seen at Brown Lake during the one survey flight conducted over this area (N. Lunn, pers. comm.). No estimate of population size exists for this area, however, a minimum of 200 bears have been counted in the area between Wager Bay, Chesterfield Inlet, and Southampton Island (Lunn et al. 1987).

   The quota for the Wager Bay area is four bears a year and is shared between two settlements. The hunting season extends from 1 January to 31 May.

   One bear was shot here at a geological exploration camp in the summer of 1986 and another was killed the next summer.

6. Owl River, Hudson Bay Lowlands - The density of dens in the Owl River maternity denning area rivals that of any area in the world (Jonkel et al. 1972). Most dens have been located in the treeless area between Sutton Lake and Rupert Creek, 30-60 km inland. At least 80 females and 150 cubs emerge from their dens each spring (Stirling et al. 1977). Adult males remain along the coastline during the ice free season. As reported earlier, the bears in this area are from the same population as those observed at Churchill.

   At least five aggressive polar bear - human interactions have occurred here since 1969; one resulted in an injured human and all involved family groups (i.e. females with cubs or yearlings).

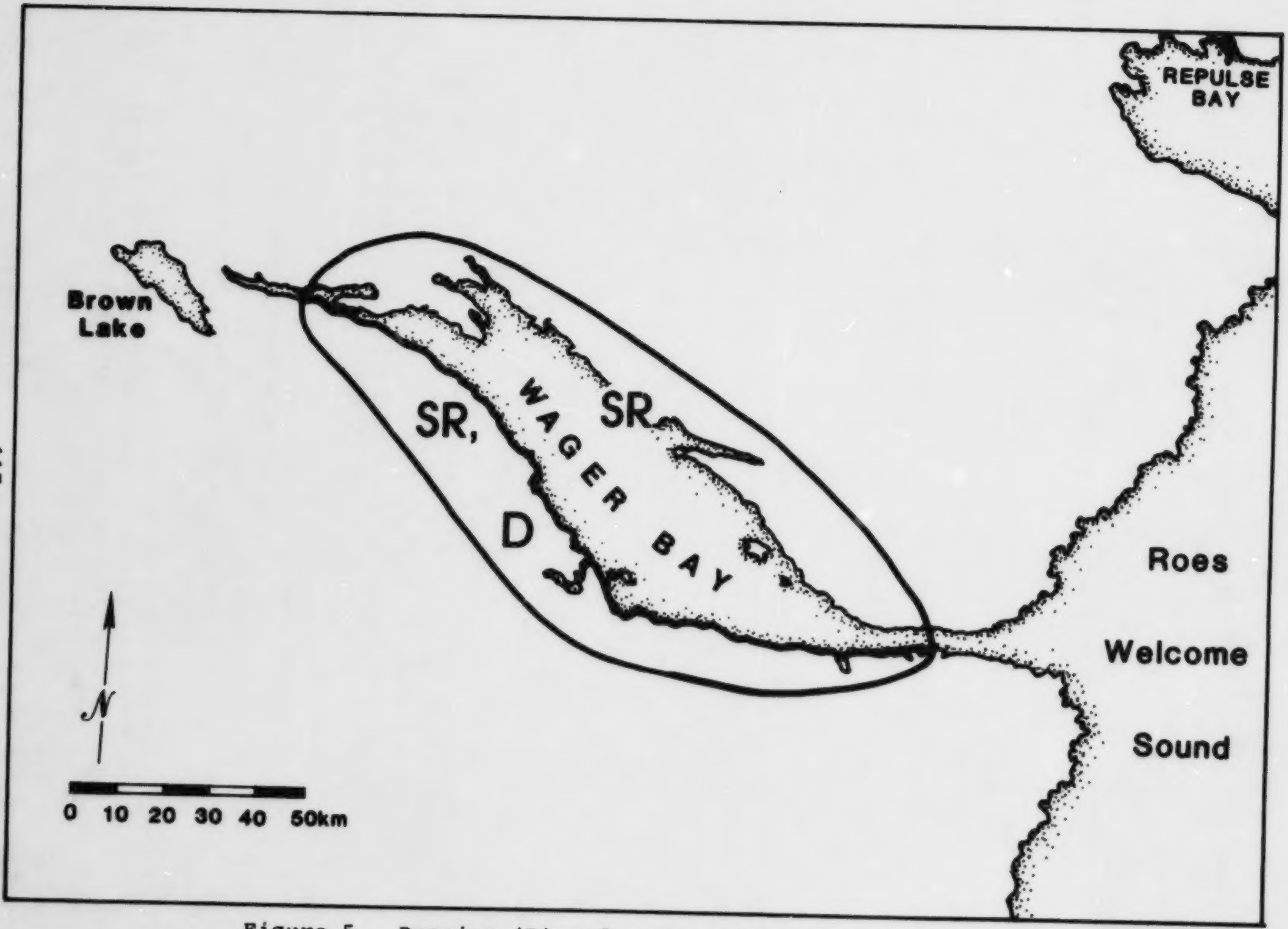
REPULSE BAY
Brown Lake
WAGER BAY
SR
SR,
D
Roes
Welcome
Sound
N
0 10 20 30 40 50km

Figure 5. Denning (D) and summer retreat (SR) areas used by polar bears near the proposed park reserve for Wager Bay, NWT.

Appendix 2. Summary of interviews with polar bear biologists, wildlife officers, and Inuit polar bear hunters.

Question 1: Please describe your research or hunting experience with polar bears and, if applicable, with grizzly and/or black bears.

1. Amstrup, Steve. Biologist. Polar Bear Project. US Fish and Wildlife Service. 1011 E. Tudor Road, Anchorage, Alaska, USA. 99503.

   a. polar bears - studied polar bears since 1980; 3 months every year in field capturing and tagging polar bears in Beaufort Sea and Chukchi Sea; behavioural observations coincidental with capture work.

   b. black bears - MSc on black bears in Idaho. Two seasons of fieldwork capturing and radio-tracking bears. Few behavioural observations because of dense underbrush.

2. Andriashek, Dennis. Technician. Polar Bear Project. Canadian Wildlife Service. 5320-122 St. SW, Edmonton, Alberta, Can. T6H 3S5.

   a. polar bears - studied polar bear since 1973; has captured and tagged polar bears in Beaufort Sea (10 seasons), Lancaster Sound (4 seasons), southeast Baffin (2 seasons), northeast Manitoba (10 seasons), northern Ontario (1 season), and Labrador (1 season). Conducted behavioural observations at Radstock Bay on Devon Island, NWT for 1 spring and 4 summers.

3. Clarkson, Peter. Wolf/Bear Biologist. Department of Renewable Resource, Govt. of NWT, Inuvik, NWT, Can. XOE OTO.

   a. polar bears - two years as bear deterrent biologist for the Dept. of Renewable Resources, GNWT that involved 2 fall field seasons of testing deterrents and detection devices on polar bears and observing their reactions at Churchill, Manitoba.

   b. black bears - 1 season capturing and radio-tracking black bears in Flathead area of Montana, USA; limited testing of deterrents on black bears at the Norman Wells dump, NWT.

4. Derocher, Andy. Technician. Polar Bear Project. Canadian Wildlife Service. 5320-122 St. SW, Edmonton, Alberta, Can. T6H 3S5.

    a. polar bears - 3 seasons of behavioural observations at Churchill dump and limited testing of deterrents at Churchill, Manitoba; 2 seasons of capturing and tagging polar bears in the Beaufort Sea.

    b. grizzly bears - 2 seasons of capturing and radio-tracking grizzly bears in coastal BC; behavioural observations limited because of dense understory.

5. Hoppe, Mark. Renewable Resources Officer, Department of Renewable Resources, Govt. of NWT, Pangnirtung, NWT, Can. XOA ORO.

    a. polar bears - 1 season of capturing and tagging polar bears in Foxe Basin; observations of polar bears while travelling on the land during 4 years as a wildlife officer; investigation of reports of problem polar bears.

    b. black bears - 2 seasons of capturing and tagging black bears in northern Ontario (frequently nuisance bears).

6. Jonkel, Dr. Chuck. Professor. University of Montana, Missoula, Montana, USA.

    a. polar bears - 8 years as polar bear biologist for Canadian Wildlife Service; spent 8 seasons at Churchill, Manitoba capturing and tagging polar bears and obtaining behavioural observations; captured and tagged polar bears in Southampton Island (2 seasons), Lancaster Sound and the High Arctic (6 seasons) and southeast Baffin Island (1 season); 1 short season of behavioural observations at Radstock Bay, Devon Island.

    b. black bears - conducted field research for PhD dissertation in Idaho.

    c. grizzly bears - 10 seasons of capturing and tagging grizzly bears in Montana; deterrent testing and aversive conditioning on laboratory and free-ranging grizzly bears; behavioural observations associated with fieldwork.

7. Kearney, Steve. Regional Biologist. Department of Natural Resources, Govt. of Manitoba. Box 28, Provincial Bldg, 59 Elizabeth Drive, Thompson, Manitoba, Can. R8N 1X4.

   a. polar bears - responsible for Polar Bear Control Program in Churchill, Manitoba since 1976; captured and tagged polar bears during that time and obtained behavioural observations of bears by themselves and interacting with humans.

8. Lee, John. Polar Bear Technician. Department of Renewable Resources, Govt. of NWT, Yellowknife, NWT, Can. X1A 2L9.

   a. polar bears - since 1979 have captured and tagged polar bears at Churchill, Beaufort Sea, High Arctic, Baffin Island and Foxe Basin; 1 season at Churchill assisting with deterrent research.

   b. black bears - 3 seasons capturing and radio-tracking black bears in northern Ontario.

9. Lunn, Nick. Biologist. Department of Renewable Resources, Govt. of NWT, Yellowknife, NWT, Can. X1A 2L9.

   a. polar bears - MSc dissertation on behaviour of polar bears during ice-free season at Churchill, Manitoba (4 seasons); captured and tagged polar bears at Wager Bay and Southampton Island (3 seasons), and at north Baffin (1 season).

10. Ramsay, Dr. Malcolm. Research Biologist. Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, Can. R3I 2N6.

    a. polar bears - 5 years capturing and tagging polar bears along the Manitoba Hudson Bay coastline and inland; behavioural observation coincidental with capture work.

11. Russell, Richard. Research Scientist. Canadian Wildlife Service, Ottawa, Ont., Can. K1A 0E7.

    a. polar bears - MSc dissertation on food habits of polar bears along the Manitoba section of Hudson Bay coastline during the ice-free season; fieldwork involved 3 seasons of capturing and tagging bears and observing feeding behaviour; one season of capturing and tagging bears in Beaufort Sea and one season investigating dens along Devon Island.

   b. black bears - coincidental with fieldwork on grizzly bears in Swan Hills and Jasper National Park.

   c. grizzly bears - 4 seasons of fieldwork in Swan Hills and Jasper National Park on grizzly bears involving capture, radio-telemetry, seasonal habitat use, behaviour of bears; 2 seasons of similar fieldwork on grizzly bears on Richards Island and Tuktoyaktuk Peninsula.

12. Schweinsburg, Dr. Ray. 34 Tamarack Drive, Whitehorse, Yukon, Can. Y1A 4W2.

   a. polar bears - polar bear biologist for the Department of Renewable Resources, Govt. of NWT for 13 years; captured and tagged polar bears at Churchill, Beaufort Sea, High Arctic, Baffin Island and Foxe Basin; behavioural observations coincidental with capture fieldwork.

13. Stenhouse, Gordon. Regional Biologist. Department of Renewable Resources, Govt. of NWT, Inuvik, NWT, Can. X0E 0T0.

   a. polar bears - bear deterrent biologist for Department of Renewable Resources, Govt. of NWT for 3 years; did 3 seasons of behavioural observations and deterrent research on polar bears at Churchill, Manitoba; captured and tagged polar bears in Beaufort Sea (2 seasons), northeast Baffin (2 seasons); Churchill area (4 seasons), and Foxe Basin (2 seasons).

   b. black bears - two years capturing and radio-tracking black bears in Manitoba; behavioural observations coincidental with radio-telemetry work.

14. Stirling, Dr. Ian. Research Scientist. Canadian Wildlife Service. 5320-122 St. SW, Edmonton, Alberta, Can. T6H 3S5.

   a. polar bears - sixteen years of fieldwork with polar bears throughout their Canadian range.

15. Taylor, Dr. Mitch. Polar Bear Biologist. Department of Renewable Resources, Govt. of NWT, Yellowknife, NWT, Can. X1A 2L9.

a. polar bears - captured and tagged polar bears in Alaskan Beaufort Sea (3 seasons), High Arctic (4 seasons), Foxe Basin (1 season), Churchill (3 seasons), Labrador (1 season), Greenland Sea (1 season), and Svalbard (1 season); behavioural observations coincidental with fieldwork.

16. Gruben, Charlie, Sr. Tuktoyaktuk, NWT, Can.

a. polar bears - has hunted polar bears for more than 25 years and killed over 200 polar bears. The most bears killed in one year were 12.

17. Jacobsen, Billy. Tuktoyaktuk, NWT, Can.

a. polar bears - has hunted polar bears for 5 years and killed about 20 bears.

18. Wolkie, Sandy. Tuktoyaktuk, NWT, Can.

a. polar bears - has hunted polar bears for 34 years since he was 16 and killed over 40 bears.

19. Wolkie, Fred. Tuktoyaktuk, NWT, Can.

a. polar bears - has hunted polar bears for more than 31 years and killed over 100 bears.

20. Anaviak, Gordon. Tuktoyaktuk, NWT, Can.

a. polar bears - has hunted polar bears for 35 years and killed over 20 bears.

21. Kaomayok, David. Cambridge Bay, NWT, Can.

a. polar bears - has hunted polar bears over 30 years by dog team and by snowmobile; has killed numerous bears.

22. Oyukuluk, Andrew. Arctic Bay, NWT, Can.

a. polar bears - was born in 1913 and hunted polar bears all his life.

23. Kalluk, Levi. Arctic Bay, NWT, Can.

a. polar bears - was born in 1921 and hunted polar bears all his life.

23. Qaminrq, Philip. Arctic Bay, NWT, Can.

    a. polar bears - was born in 1933 and hunted polar bears all his life.

24. Taqtu, Juda. Arctic Bay, NWT, Can.

    a. polar bears - was born in 1937 and hunted polar bears all his life.

25. Evik, Jaco. Assistant Renewable Resources Officer, Department of Renewable Resources, Govt. of the NWT, Pangnirtung, NWT, Can.

    a. polar bears - has hunted and observed polar bears for over 25 years.

Question 2: These are present and proposed National Parks and Historic Sites in northern Canada. Are any of these areas used by polar bears?

1. The answers to this question are presented in Section 3.2 of Results and Discussion and also in Appendix 1.

Question 3a: What precautions would you recommend to a tourist who is getting ready to travel through areas where polar bears roam?

1. Every person interviewed always carried a firearm whenever they travelled in polar bear habitat. They recommended that a firearm always be carried but only if people knew how to use it. The type of firearm recommended varied. Twelve gauge pump shotguns were usually recommended because they can deploy several types of deterrents as well as live shells and are easy to learn how to use. They are also primarily defensive rather than hunting weapons. Several biologists felt safer with handguns because they are always at their side, however, these require a great deal of practice to to be proficient in their use. They are strictly licensed in Canada. Two biologists preferred rifles (minimum bore .350) as these are more accurate than shotguns.

2. A tourist should carry deterrent devices after determining what are the most effective ones for their situation, learning how to use them properly and understanding the limitations. Deterrent types that

were recommended were crackershells or bird bombs, flares, red pepper spray (not tested on polar bears though) and a plastic 12 gauge deterrent shell being developed. Twin or teleshot was not recommended. If people are travelling around Churchill, it was recommended that they carry an air horn and use it or shout intermittently to warn sleeping bears of their approach.

3. Camps should be kept clean of food, garbage and carcasses. Food and garbage should be kept in airtight containers to minimize dispersal of odours, and be placed downwind and some distance from sleeping tents.

4. Tourists should travel in groups and stay together especially if there is only one firearm in the group. A group of people will appear more intimidating to a bear.

5. Bears should never be approached knowingly, especially if they are on a kill or accompanied by other bears.

6. A portable tripwire alarm system that is very compact and reliable should be carried by everyone planning to stay overnight. This can be set up around tents to warn of the arrival of a polar bear. Otherwise some other alarm system should be rigged up that will make enough noise to warn people of an intruder. For example, a stove or pots and pans could be tied to the cached food some distance from the sleeping tent. If a bear approached, the noise from the pots and pans could waken the camp members. If nothing else, a night watch should be maintained as bears will follow trails to see what is at the end.

7. People who had used dogs that were familiar with polar bears and reacted to the intrusion of a bear by making noise were highly recommended. However, dogs should be staked to keep the bear away from the tents and only dogs that are experienced with bears should be used.

8. Tourists should become familiar with polar bear ecology. The Department of Renewable Resources, Govt. of NWT and other agencies have suitable literature available for distribution to the public (e.g. Safety in Polar Bear Country). With increased knowledge about polar bears, tourists should be less likely to become involved in confrontations.

9. If people are not familiar with firearms, they should consider hiring someone who is familiar with firearms and with polar bears.

10. Tourists should always be alert for polar bears. If the weather is poor (foggy, blizzardy), then travelling should be curtailed to prevent a sudden interaction with a polar bear. However, if confined to camp, bears may still be travelling and people should remain alert. In the spring, bears may be resting in gullies or hollows in the snow. During the ice-free season, bears may be resting on land, hiding behind rocks or shrubs. It is better to camp inland several km and to stay away from beaches and points of land that seem to attract bears. During winter, camps should be located near the coastline as bears frequent open leads, floe edge, pressure ridges and rough ice at that time of year.

11. Another suggestion to tourists was to avoid areas where there are polar bears. The wildlife officer or hunters in the nearest community should be able to inform tourists of where polar bears have recently been seen or where they may be likely to occur.

12. Another recommedation was to carry a HF radio (e.g. SBX-11) which sometimes can be rented from a local Hunters and Trappers Association (HTA) or from a communications company down south.

13. When setting up camp, tourists should space their tents so there is enough room for a bear to get away from them if confronted in camp. A window in a tent is a good idea so that approaching bears can be watched for.

Question 3b: What precautions would you take?

1. Everyone interviewed said they would carry a firearm. As mentioned before, type of firearm preferred varied. Eleven of the fifteen biologists carried shotguns as they could also deploy deterrents this way.

2. Three biologists said they would take a portable trip wire alarm for their camp.

3. Seven biologists would try to avoid bears by inquiring to determine where polar bears have been seen or should be.

4. Two biologists and four hunters said they would take dogs that are experienced with polar bears and could be used as alarms. Most hunters have dogs at their camps.

5. The biologists all carry deterrents. Types of deterrents carried varied.

6. No one would ever approach a polar bear knowingly.

Question 3b: The present National Parks policy does not allow firearms in parks. Should this policy be changed in northern parks where a tourist might encounter polar bears? (Hunters were not asked this question)

1. Eleven of the 15 biologists felt the policy should be changed but only if use of firearms was strictly controlled. Three biologists thought that tourists should avoid areas with polar bears. If they want to go to those locations, then they should not be allowed to carry firearms but should be accompanied by an armed guide who is also familiar with polar bear ecology. One biologist did not feel the policy should be changed but that there should be strict guidelines on tourist behaviour (minimum group size, garbage at campsites cleaned up daily, designated camping areas protected by bearproof fencing and gates, etc.).

2. The two reasons used to rationalize a policy change were that:
   a. polar bears present a definite risk to human safety; and
   b. the present and proposed northern parks are in very remote locations. Tourists travelling in these areas should consider taking a firearm along for emergency survival purposes.

3. Control of firearms and tourists was discussed in the answers to this question. Condensed comments follow:
   a. the northern parks have few access points. Most if not all tourists pass through those. Firearms should be declared and sealed. Permits should be issued. Park wardens could evaluate people's firearm knowledge or require provincial firearm safety course. As people leave, seals should be checked. A small fine should be levied for any broken seals so that people do not practice with firearms in the park (practice should be done at home);
   b. park officials should specify acceptable types of firearms (e.g. 12 gauge pump shotgun with short barrel and plug removed, rifle with minimum bore size of .350, no handguns);
   c. park policy should be available to visitors and charges for violations should be advertised through posters, brochures, etc. Officials may want to have

a releaser statement signed by all visitors to ensure they are aware of dangers;

d. park officials may want to ensure that a variety of deterrents and ammunition are available for sale in each community or park office (because of the problem of transporting dangerous goods). Another alternative is to supply such items to tourists as they travel through park such as is done at Churchill by Department of Natural Resources, Govt. of Manitoba when issuing cracker shells;

e. if armed guides are to be hired, then some kind of certification should be established so that guides are properly qualified. Armed guides accompany groups at the National Historic Sites at Churchill and this may be the most efficient way to handle groups;

f. park officials may want to stratify their parks with respect to need for firearms. For example, bears are virtually never seen inland in Auyuittuq during the summer. If people only travel there then, no firearm may be necessary. If people are travelling around Kivitoo, firearms should be carried;

g. park officials should post locations where polar bears are most likely to occur and recent sightings so that arriving tourists can avoid those areas. Area closures may need to be invoked at times. Park should be patrolled regularly to keep closures up to date;

h. control of garbage should be assessed. Since virtually all visitors are hikers, a carry in and carry out policy should apply to food and garbage. Bearproof containers should be carried by backpackers and be available from park warden offices or in the communities;

i. park officials may want to offer a half day orientation course to visitors about polar bear ecology and behaviour. At the least, brochures should be available for people to read; and

j. park management strategies should accomodate a variety of styles of visit.

Question 4a: How would you recognize an aggressive bear?

When answering this question, we were cautioned numerous times that each bear is an individual and that any one, a combination or none of the following warnings may be exhibited by an aggressive bear. For the most part, polar bears are very passive but they have the potential to become aggressive at any time. Aggression can also be divided into two types. One type is where the bear does not want a person around for any number of reasons (protection of cubs or of food, invasion of personal space, etc.) and the other type is where the bear acts as a predator. One can probably expect to receive some warning in the first type of aggressions but no warning can be expected if the visitor is the intended prey.

1. The following types of polar bear behaviour have been seen at one time or another and interpreted by biologists and hunters as aggressive:
   a. standing sideways to show off size (rare and not always obvious);
   b. curling upper lip back and extending lower;
   c. huffing loudly also described as loud exhalation, snorting or blowing sound (typical);
   d. growling, hissing or roaring (unusual);
   e. staring directly at a person while facing them (typical);
   f. jaw popping sound also decribed as smacking lips, snapping jaws together and chomping teeth (typical);
   g. carrying head below shoulder level with ears close to its head. Head may be swaying back and forth. A bear normally stands on all four feet;
   h. pawing ground or smashing some object with its paw (unusual); and
   i. moving quickly towards a person as if it is bouncing on its front feet and body is lowered. This was felt to be a description of a bluff charge. From all accounts, it appears as though bluff charges are rarely seen. This suggests that any time a polar bear is moving quickly towards a person with its body low to the ground, it should be interpreted as a true charge. The bear's eyes will be on the person it is rushing and a charge does not usually start until the bear is within 30 m or so of a person. A bear may sometimes stand up before initiating a charge. Other warning signals may or may not precede a charge. Hunters felt that if a bear that is intent on killing a person at the end of the charge it will bite them and not swat at them with its paws. On the whole, charges are uncommon.

Question 4b: How would you recognize an unaggressive bear?

Again the behaviour of a bear that is acting neutrally or inquisitively towards a person may vary with each bear. Once a bear has determined what the person is, its behaviour could become aggressive or it may just walk away.

1. The following types of behaviour appear to be unaggressive:
    a. standing on all four feet or moving slowly and stopping occasionally during approach. Movements appear to be relaxed (typical);
    b. sniffing the air frequently with head held high and nose pointing up. Ears may be forward or sticking out. The bear may be craning with its neck (typical). A bear may sometimes stand on its hind legs while sniffing the air;
    c. circling around downwind of the person in order to catch a sniff (typical);
    d. not looking directly at the person (typical); and
    e. not vocalizing (typical).

Question 4c: Would a close approach (20 m) signify aggression?

A close approach can result from two circumstances. A polar bear may be surprised at close quarters or a bear may have been constantly approaching a person from a distance. Neither of these situations definitively implies aggression. However, in the second instance the experts would become concerned if deterrents had been dispatched during the approach of the bear and the bear did not appear to avoid them. Certainly, people said that when a bear came within 20 m that left little time to react should the bear charge. Most would try to deter that bear before it came within 100 m. Most bears should be able to determine the identity of a person by the time they are 100-150 m distant.

Question 5: How can you tell whether a bear is searching for prey or hunting?

1. A person can discern from the tracks of a bear whether it has been travelling or hunting. When travelling, the tracks will head in one direction. The trail may occasionally veer off as the bear checks out something unusual but then it will return to its original direction. When hunting, tracks will meander back and forth along ice ridges, the floe edge, rough ice, etc. Sometimes a spot can be found where the snow is melted as a bear lay waiting for a seal to emerge or a smashed in seal lair will be seen.

2. When a bear is hunting, it will amble along at about 5 kmph, stopping, looking, and sniffing occasionally with its ears in an alert position. If a scent is caught and

appears close by, it will often lower its nose to the ground. The actual hunt may take two forms (there are variations on these forms):

a. still hunting - a bear will sit, stand on all four feet or lie beside a seal hole or lair waiting for the seal to emerge. Most hunting seems to be in this form and sometimes it can be difficult to move a bear away from its spot; and
b. stalk - if a bear spots a seal on the sea ice it may stalk it as a cat stalks a bird. From a distance of 100-300 m, it will drop its head and lower its body. With its eyes focussed on the prey, it will slink over the ice moving fairly quickly using irregularities in the ice to hide until it is within 25-35 m. Then it will make the final rush and pounce. A variation is to slip in and out of any open water while approaching the prey.

Question 6: If a person spotted a polar bear and had no deterrent with him, how should he behave?

Not all hunters were asked this question because they would never consider going somewhere without a firearm.

All responded by saying that a person's behaviour would depend directly on the circumstances of the situation. However there are a few things that are always done.

1. These are:
    a. always keep an eye on the bear. It can move very quickly and can often hide in surprisingly open habitat;
    b. never move between a female and her offspring; and
    c. if travelling with a group, band together and let everyone know that there is a bear in the area.

2. All the biologists said that if a bear and person have spotted each other, the person should make quiet noises, determine wind direction (as the bear may attempt to circle so that it is downwind) and slowly but steadily walk away from the bear. Opinion was divided on whether a person should sit tight or leave if they have spotted a bear and it has not seen the person.

3. Several biologists suggested dropping items as the bear approached to distract it from the person's retreat. If there is a major distraction such as a bird colony in the area, the person could attempt to lead the bear there.

4. If a bear is intent on attacking the person, they should defend themselves as aggressively as possible. Pieces of rock or ice can be thrown at the bear. In the case of a smaller bear, a person could try opening up their coat so as to look larger.

5. If the bear does get close, the person should follow their gut reaction.

Question 7: Do you believe that polar bears will actively hunt people?

One biologist and one hunter felt that polar bears would not hunt people. One biologist and one hunter did not know and the rest of the biologists and hunters thought that polar bears did at times look upon people as potential prey.

Hunters also said that if there are lots of seal in an area for a bear to hunt, it is unlikely that it will hunt humans.

1. Half of the hunters and several biologists thought that hungry, skinny bears were the most likely bears to behave in such a manner. Two biologists did not believe that a healthy bear would act this way.

2. A number of biologists cited the deaths caused by polar bears as examples of such behaviour.

3. Several hunter and biologists said that they had observed bears stalking them and believed that a healthy bear could very likely behave this way. They mentioned that bears are opportunistic hunters.

4. A bear following a person's tracks is not necessarily hunting the person. The bear may only be curious and want to know what is making the tracks.

Question 8: Do you think polar bears around Churchill react differently to humans than bears elsewhere? If so, why?

Hunters were not asked this question and five biologists could not answer as they had no comparative experience.

1. Two biologists felt that Churchill bears did not behave differently except that those bears that had been around or exposed to people and become used to them (habituated) did not react as quickly to human stimuli

as bears that were encountering people for the first time.

2. Three biologists said that Churchill bears during the ice-free season behaved differently than bears out on the sea ice that are actively hunting. Bears at Churchill are not actively hunting but spend most of their time resting and appear to be less likely to respond to people than at other times of the year. One biologist said that males have a much lower testosterone level during the ice-free season and that the physiology of all bears during this season resembles that of a bear approaching hibernation. This implied that they may be less aggressive and less flighty at this time of year.

3. Five biologists thought that bears in the vicinity of Churchill received more exposure to humans and thus were less likely to respond to people by running away in comparison to bears that had no exposure to humans. They used bears at the Churchill dump as an example.

Question 9: Are there specific groups of polar bears that cause more problems for humans than others (eg. sex, age, condition)?

1. Virtually everyone stated that a hungry bear was the most likely bear to come into contact with people. Subadults (they are often inefficient hunters) and old male bears seem to get into such a state more frequently than other bears.

2. At Churchill, cubs-of-the-year that are brought to the dump by their mothers seem to come back the next year as subadults that are troublesome.

3. Half the people interviewed said subadult males.

4. Several biologists and hunters said that females with offspring may act aggressively if surprised.

5. One hunter said that adult males during the breeding season (March - May) could be very aggressive if with an oestrous female.

Question 10: In southern parks, both grizzly and black bears have learnt to bluff charge tourists to obtain food. Do you think polar bears would learn this behaviour?

Hunters were not asked this question because they are not familiar with this behaviour.

1. One biologist had no opinion. Several biologists did not believe this would happen because polar bears do not appear to bluff charge.

2. Most of the other biologists thought that polar bears have the potential to learn this behaviour, however, polar bear - human interactions are much too few for bears to have the opportunity to learn this behaviour. This is probably a reflection of the low density of polar bears and people in comparison to black bear, grizzly bear, and visitor density in southern parks. At Churchill, where the densities of people and bears are the highest, such behaviour has not been observed, perhaps because people rarely walk around carrying food.

Question 11: Will polar bears approach humans regardless of the presence of attractants (other than the person)? (i.e. Are bears curious?)

1. Almost everyone interviewed mentioned how curious polar bears are. The behavioural observations that suggested curiosity were:
   a. while working on a drugged bear on sea ice or land, at least five biologists have had other bears approach and just stand and watch what was going on. This may be because many bears have never seen humans before and are investigating what they are;
   b. anything that is out of the ordinary is investigated on the offchance it might be food;
   c. bears will follow trails or paths to see what is at the end. Inuit, if they were hunting bears, used this trait to bring bears into camp by dragging a dead seal behind a komatik; and
   d. bears have been seen to veer off their travel route to approach items such as a plastic bag windsock, dirty snow, fuel drum, and plastic bucket.

Question 12: Do polar bears avoid people? (Hunters were not asked this question)

The simple answer was that some do and some do not. When bears spot a human, most bears will do some kind of investigative approach in order to determine what that unknown object is. As soon as they determine that the object is a human, most bears will leave. They should be able to catch a person's scent from at least 150 m or farther. If deterrents are used this should ensure that most bears will avoid people. Several biologists suggested that bears that have been shot at or had an unpleasant experience with people will avoid people in their next encounter.

However, there will always be the odd bear that does not avoid people. There is a chance that no matter how hard a person has tried to not attract bears, one bear will come anyways.

Appendix 3. Accounts of injurious polar bear - human interactions

A. Injuries

1. Date: some years back
Location: winter trapline between Resolute and Pond Inlet
Person: Inuit man, adult
Bear: skinny polar bear, sex and age unknown

A hunter was bending over setting a fox trap when he felt something pulling and tearing at the many clothes on his back. He reached over his shoulder with his snow knife and hit the bear in its eye. The bear let go and the man was able to run to his sled and grab his gun. Despite the injured eye, the bear charged again and was killed.

It is not clear whether the hunter was injured by the bear.

This incident was related by hunters from both Arctic Bay and Cambridge Bay.

2. Date: some years back
Location: sea ice somewhere in NWT
Person: Inuit man, adult
Bear: adult female bear with subadult

Three hunters were chasing a female and her subadult when they managed to kill the subadult. The older hunter was behind the other two when the female caught the old hunter. She attacked and he used his caribou parka to try to distract her. This worked momentarily and then she bit him on the buttocks and left. He received four puncture wounds and that was all.

This incident was related by hunters from Arctic Bay.

3. Date: 1 June 1961
Location: exploration camp, Christoffer Bay, west coast Ellef Ringnes Island
Person: Tony Overton, adult, male
Bear: subadult (about 6 ft long) female bear, single, good condition

Tony Overton and three other men were out on the sea ice waiting for the helicopter to return with more dynamite. They had one small tent among them in which soup had been spilt. The ensuing mess caused three of them to sleep outside while one person stayed in the tent.

At 4 am, Overton awoke to see a polar bear walking towards him. The bear was only 8-10 m away. With his left arm, he reached out to grab his rifle (it was the only one there) and as he did so the bear ran up and bit his arm and began dragging him away. Overton yelled 3 times and when the bear had dragged him about 8 m, Bill Tyrlik awoke. Tyrlik saw what was happening, hopped out of his sleeping bag, and grabbed the rifle. When Tyrlik moved, the bear saw him, dropped Overton and charged Tyrlik. Tyrlik just had time to pick up the rifle, load it and bring it to his hip to fire when the bear was in front of him. Tyrlik shot and hit the bear between the eyes. The bear dropped at his feet.

Overton had minor lacerations and punctures to his left forearm. He was hospitalized for more than 24 hours at a military hospital in Thule, however, he felt he did not need to be in hospital that long. He received rabies shots in his abdomen but the rabies test on the bear was negative.

He recommends carrying firearms in the Arctic. He confirmed this story through a telephone call on 15 May 1987.

4. Date: 1 October 1966
Location: near Fort Churchill, Manitoba
Person: 12 year old boy
Bear: subadult male bear wounded with firearms earlier in the year and also on the same day of the attack (.22 cal)

Dr. C. Jonkel investigated this attack but his report was not available.

5. Date: 2 November 1967
Location: Dene Village, Churchill, Manitoba
Persons: A. Thorassie, Cree Indian, resident, adult, male
A. Nagle, Cree Indian, resident, adult, female
Bear: subadult male bear

The bear had discoloured fur and garbage in scats suggesting that it had been feeding at the dump for several months. In very good condition but probably having been harassed by people throughout the period, it fed at the dump until it had little fear of men. Dr. C. Jonkel investigated this attack but his report was not available.

6. Date: 16 March 1969
Location: tributary to north fork of Rupert Creek, 160 km south of Churchill
Person: John Spence, adult male native trapper
Bear: adult female bear with 3 month old cubs

John Spence was searching for beaver houses. As he moved upstream, the creek became very narrow and enclosed by a canopy of willows which forced him to bend over as he walked. Suddenly a polar bear jumped at him, knocked him down and bit him several times in the upper arm. The bear then fled with her two cubs.

Spence walked back 1.5 km to camp and the bear followed him partway but did not attack again. Shortly thereafter, Frank Spence, set out to hunt the bear. She fled when she saw him and showed no signs of aggressive behaviour. He eventually was able to kill her.

Spence's arm was eventually amputated because of the bites.

The female had apparently been near an occupied beaver house for several hours and had scraped the snow off it before Spence arrived. She must have heard him approaching through the willows.

Dick Russell, Canadian Wildlife Service, investigated this incident and submitted a report.

7. Date: 15 November 1969
Location: Churchill, Manitoba
Person: Bradley White, Churchill resident, 7 year old boy
Bear: subadult (yearling) male bear

White was walking to church around 9:30 am. As he reached the Catholic church a young polar bear came up and hit the boy knocking him to the ground. The boy played dead and the bear walked away. It was later shot.

White received a 6 inch cut across the left thorax region which was not serious. Andy Cook witnessed the attack.

8. Date: April 1970
Location: Somerset Island
Person: Frank Brazo, visitor accompanying C. Jonkel
Bear: adult female bear with 3 month old cubs at den

From the helicopter, Chuck Jonkel and Frank Brazo saw a female with cubs and thought that her den must be nearby. About 0.5 km away they found a den and landed the helicopter. Chuck Jonkel was familiar with den construction and layout and so walked around the snowdrift. Frank Brazo followed him and Jonkel did not explain why they had approached in that fashion. Jonkel crawled about 8 m into the den while Brazo waited outside. At that point, Jonkel became nervous and backed out just in time to see Brazo walking back to the helicopter over the den. Two yellow arms broke through the snow, grabbing Brazo. The bear began to chew on him. Then the bear heard the helicopter and looked at Jonkel, the machine and her cubs. This gave Brazo an opportunity to escape. The bear began to follow but then looked back at her cubs and retreated to them.

Jonkel did not have a firearm with him.

This was confirmed by a telephone call with Chuck Jonkel in December 1986.

9. Date: 19 August 1975
Location: Geologic Survey of Canada camp, Cunningham Inlet, Somerset Island
Persons: John LeGault, summer student employee, adult
Robert Taylor, party chief, adult male
Bear: subadult male bear in good condition, tagged by CWS on 9 July 1975

At 2:30 am, members were awakened by the cries of a dog. Two students rushed out and saw a polar bear attacking the chained dog. One of the students ran 25 feet to the parkoll (a large insulated tent) to get one of the two camp guns, however, the chamber was empty. The bear charged him but did not get him. As John LeGault emerged from a tent, the bear attacked him. The bear began dragging him. LeGault had severe lacerations and bites about the head. A bloody footprint was left on the outside of the tent wall.

Robert Taylor saw LeGault with the polar bear on him and ran to the parkoll to grab the gun from the first student. The bear dropped LeGault and charged Taylor who pulled the firing pin but nothing happened. He had not pulled the bolt back far enough to load a cartridge. The bear bit him several times around the side of his head, neck, shoulder and back and proceeded to drag him away from the tents by the back of his neck.

A third student who had his own rifle beside his bed emerged from his tent and as he ran around the tent saw the bear dragging Taylor 20 m from the camp. He aimed and hit the bear in the neck. It dropped Taylor and died.

Both LeGault and Taylor were flown to Frobisher Hospital. They were hospitalized over 24 hours. The dog was seriously mauled and had to be killed. The bear had also chewed on both rubber pontoon boats.

Several investigations produced reports on this incident.

10. Date: 11 August 1980
Location: Kangiqturuluk, Kingnait Fiord
Person: Joanasie Kakee, Inuit, adult
Bear: immature male bear in normal condition

Around 11:30 pm, Joanasie Kakee was sitting near the water at his hunting camp mending his net when a polar bear attacked him from behind. The campsite had some hills around it and he did not see the bear approaching. It did not make any warning sounds. It is not known whether there were any caracasses in camp. As he was struggling with the bear he called out and Pauloosie Kakee who was making tea in the tent came out and shot at the bear twice. The bear did not stop his attack until the third shot when Pauloosie hit it in the back leg. The bear then walked about 1 km down the beach and sat down. Pauloosie chased the bear and shot at it until it fell down and died.

The back of Joanasie's head was torn open and the two of them went back to Pangnirtung for medical attention. He was flown to Frobisher to the hospital.

This incident was investigated by a wildlife officer.

11. Date: 14 November 1983
Location: Cape Churchill, Manitoba
Person: Fred Treul, American tourist, adult
Bear: lean adult male bear that was not killed

Treul was part of a group of tourists in a tundra buggy who were "excitedly photographing an Ivory Gull early in the morning." Treul leaned out of a window for a better angle when a polar bear stood up from under the buggy, bit him twice on the arm, and attempted to pull him out the window. The tour operator reached out with an axe and hit the bear several times before it let go. It took over 16 hours to get back to Churchill and Treul suffered severe blood loss.

Treul was flown to Winnipeg for medical attention and was hospitalized for several weeks.

Steve Kearney, regional wildlife biologist, investigated the incident and verbally transmitted the information.

12. Date: 18 December 1983
Location: Panarctic exploration camp, King Christian Island
Person: Gary Edmonds, adult, male, new camp employee
Bear: adult female with a one yearling

It was dark outside. At 12:45 am Gary Edmonds and Dana Moleschi went to dump the garbage and pump water. Moleschi was getting ready to pump water when Gary came walking around the corner with a polar bear right behind him. Moleschi started running to camp and looked back to see Gary fall. The bear had swatted him across his buttocks causing him to fall down. Once down, the bear grabbed him by his arms and proceeded to drag him for 300 m. Gary struggled the whole time and this probably increased the severity of his injuries as the bear hung onto his arms to drag him.

From the time that the bear began dragging Gary away to when Rick Gale found him, no one but Gary knew what was happening. Gale mentioned at the time that at one point the cub came and grabbed one arm and started to pull. The mother at that point dropped Gary and went after the cub and chased it away. Gary's comments at the time were that the bear was not so vicious when he stopped fighting.

Moleschi woke up the radio operator and got the gun. He went outside and fired 3 shots in the air. Moleschi returned to the radio room and contacted Rick Gale and Ed Langevin. They were together about 1/2 km from camp. Rick was on the loader and Ed in the pickup. Ed drove back as quickly as possible and picked up Moleschi. They were limited in their area of search by the amount of snow. Gale on the loader had more maneouverability and Moleschi directed him to the general area where he though the bear may have headed.

Gale started looking and about 10 m past the dock saw the bear but could not see Gary. As he got closer, he could see the bear was lying on top of Gary, sort of hiding him. Gale could see Gary's feet and he drove up and hit the bear with his forks to get the bear off. He thought Gary was dead and to prevent the bear from attacking further, he drove the loader over Gary's body. The bear backed off about 3 m and then he saw Gary move his hand and told Gary to get under the loader. When the bear saw Gary move, it charged Gary again but just as the bear got close, Gale dropped the forks onto the bear, hitting it and causing it to move off about 7 m. The bear then charged the loader from another angle and Gale not being able to move, honked the horn. As the bear backed off, Gary crawled out from under the machine and up into the loader.

Langevin believes that the equipment and noise scared and confused the bear. This contributed to distracting her and helped to keep Gary alive until he was rescued.

Meanwhile, Moleschi in the pickup heard from Gale that he had found Gary and the bear. Moleschi turned the pickup to face the area and saw the bear running away. He got out of the truck and shot at the bear from 30 m. The bear was wounded but managed to get away.

The next morning two Inuit were brought in from Resolute with the RCMP. They tracked the bear and found here about 8 km from camp. Moleschi's shot had taken her bottom jaw off and she was dying. The Inuit shot and killed her about 10:00 am.

In the confusion of the evening before, the bear's cub was left behind. It was shot by the cat skinner when he saw it heading back into the camp area.

Gary was brought inside and they administered first aid to him. Langevin estimates that from the time that the bear first attacked Gary to when he was brought back into camp was about 12-15 minutes. Gary was medivac'd out and hospitalized for an extended time. His scalp was torn off, however, from the wounds it appears that the bear clawed the skin off rather than chewed it off. Apparently Gary was lying on his stomach and the bear kept trying to roll him over with her paws.

The camp had only been opened two days and the crew had arrived that evening. They backtracked the trail of the female and her yearling. She had been walking along the beach and it appears that as soon as she was downwind from the camp, she made a right angle turn and headed straight for it. She went to the sump area and was probably there about half an hour taking apart the sewer line when she was surprised by the appearance of Gary. She then followed him and attacked.

This information was substantiated by Ed Langevin (phone call and letter) who at the time was a relief foreman subcontracted to Panarctic through Ardill Personnel.

13. Date: 11 August 1984
Location: North Knife River Delta, Manitoba
Person: Cecil John Voisey, resident of Churchill, adult
Bear: adult male bear in good condition, approximately 400 kg

Two separate parties of 3 people each arrived on Friday night, set up camp and caught several fish before settling back into camp for the night. Saturday morning, four went fishing and Brian Coma and Cecil John Voisey went for a walk. They did a 1 mile junket and saw no sign of polar bears.

In the pm, Voisey went farther along the shoreline by himself and on his return around 7 pm saw fresh bear tracks where he had previously walked. He was within 500 m of camp walking through the willows when he heard the bear snort and noticed the bear charging him from a distance of about 20 m. Voisey shouted and ran, throwing down his .22 rifle in the hopes the bear would stop to sniff it. But, the bear did not stop and as it got close, Voisey lay down pretending to be dead. The bear grabbed him by the head and neck area and shook him. Voisey continued to play dead and the bear began to bite and claw him and then dragged him away.

Voisey's friends were at camp and noticed the bear chasing him. They grabbed a shotgun and rifle and ran towards Voisey and the bear. They shot into the willows to scare the bear who tried to drag Voisey farther away. Finally they wounded the bear which made it leave Voisey and run into the open. Voisey's friends then killed the bear with a volley of shots.

Voisey received bad wounds to the back of his neck and some minor ones on his back. He had teeth marks on his buttocks and a large chunk of flesh ripped out of the back of his left leg. He was in hospital for a while.

Statements were taken by the RCMP. Some alcohol was involved and the bear had two .22 holes in his jaw and top of his muzzle. Voisey claimed not to have fired at the bear.

14. Date: 5 January 1985
Location: Pelly Bay
Person: Fabian Oogak, Inuit, male, adult
Bear: male bear

On a Saturday night in Pelly Bay, people were at the community hall when children came in shouting that there was a polar bear in town. Fabian heard that the bear was near his house and he rushed out without his parka on and caught sight of the bear. As he ran down the hill towards his home, he lost sight of the bear. It had gone around to the side of Oogak's house and was feeding at his fish cache. As Oogak approached, the bear charged. Oogak tried to escape between two houses but slipped and fell. He rolled onto his stomach and tried to play dead. The bear did not bite Oogak right away but then bit him on the shoulder, then the head and then the nape of the neck. After another bite in the upper back, the bear lifted Oogak up and shook him. Oogak then heard a rifle shot and the bear dropped Oogak and ran.

Zachary Oogak followed the bear and it was killed.

Oogak was medivac'd out.

A wildlife officer investigated the incident.

B. Deaths

1. Date: long ago
Location: Atkinson Point
Person: Inuit man, adult
Bear: large polar bear

A man and his wife were camped near Atkinson Point asleep in their snowhouse. A polar bear came at night and attempted to break into the snowhouse. The man awoke, grabbed his knife but no clothes and proceeded to stab at the bear. The cold finally overcame him and he was killed by the polar bear. After the bear had killed the man, it left.

The man's brother then chased the polar bear and was able to kill it with his knife. The bear was in good condition.

This incident was related by Sandie Wolkie from Tuktoyaktuk.

2. Date: 17 November 1968
Location: outside of Fort Churchill, Manitoba
Person: Pauloosie Meeko, Inuit, Akudlik resident, 19 year old male
Bear: subadult male bear in normal condition but garbage in stomach

Meeko and several companions saw tracks of two bears outside the settlement along the Hudson Bay coast. The boys followed the tracks through the snow and Meeko approached too closely where the bear was bedded without seeing the bear. The bear attacked and killed him.

Dr. C. Jonkel investigated this incident but his report was not available.

3. Date: 22 March 1973
Location: seismic crew camp on sea ice near Kendall Island
Person: adult male foreman
Bear: old, skinny, adult male polar bear with poor teeth

As related by Jim Bourque, who was the wildlife officer responding to the incident, on 26 October 1987.

A seismic crew camp had just moved to a new site on the sea ice off Kendall Island in the Mackenzie Delta. They arrived in the morning and began making an airstrip for the rest of the crew and supplies to arrive.

At noon, the foreman went to the cat skinner and told him that he would work the cat so that the cat skinner could go to lunch. After lunch, the cat operator went back and told the foreman that he had seen a polar bear track in the camp.

The foreman went back to the cookhouse and had lunch for about an hour. Then they went outside to look for the bear.

The cookhouse was on a sleigh about 4 feet off the ice. The space under the sleigh was not enclosed. Earlier in the day, the cook had poured out the coffee grounds beside the front steps.

The foreman left the cookhouse first and as he walked down the stairs, the bear which had been hiding under the sleigh, stood up and hit the foreman from behind, smashing his skull. The bear then dragged the man off and began to eat him.

Somehow the bear was chased away with heavy equipment and by 3 pm, when it was now dark, Jim Bourque, who was the wildlife officer called in, arrived. He stepped out of the bombardier where the bear was. The bear charged and Jim killed it.

Jim examined the bear and found it to be an old, adult male that was very thin and whose teeth were in poor condition.

4. Date: 5 January 1975
Location: Adgo P-25 artificial island, 5 mi south of Garry Island
Person: Richard Pernitzsky, rig worker, adult, 18 years old
Bear: adult (5 years old) male bear, 200 kg, in poor condition with virtually no intraperitoneal fat, tagged by CWS 22 March 1974 and weighed 240 kg then.

Around 9:15 am, Pernitzsky was bent over chopping ice from in front of the door to the sewage treatment building when the bear attacked him. The bear probably used the snowpiles that originated from shovelling snow off the deck to climb onto the barge. Claw marks were seen on the door. Workers were inside within 8 m but no one heard a sound.

The bear proceeded to attack and drag Pernitzsky several hundred m from the barge before stopping to consume him. The bear was found with the remains of Pernitzsky about a 1.5 km from the barge. Vehicles approached and two attempts were made with the flare pistol but the bear just dragged the body farther away. It was wounded several times before it was finally killed after a lengthy chase.

There were no firearms in camp. It was dark outside and cold (-45 C). Garbage had been incinerated and the campsite was clean. No bears had previously been seen close to Adgo P-25.

Several investigations reported on this incident.

5. Date: 22 July 1977
Location: Magdalena Fjord, north of Spitzbergen, Svalbard
Person: Austrian tourist, male, adult
Bear: "huge" bear

A group of tourists were brought to the Fjord by boat for a 1-2 day camping trip. Fifteen campers pitched their tents. At some point during the night, a polar bear attacked a man and carried him to an ice floe where it proceeded to devour him. Apparently, the victim heard a sound outside his tent and stuck his head out (like a seal emerging from a hole) and the bear attacked him. The other campers climbed a nearby glacier and watched helplessly. The campers were rescued by a helicopter the next day.

Confirmed by Erik Nyholm, 6 April 1987.

6. Date: 29 November 1983
Location: Churchill, Manitoba
Person: Thomas E. Mutanen, Churchill resident, adult male
Bear: subadult male bear, 140 kg, normal condition

Just after midnight on 29 November 1983, the Polar Bear Alert Staff received a phone call that a bear had been sighted near the Royal Canadian Legion. The area was checked and no bear found. Then at 12:20 am, staff were informed that a man was being mauled at the Arctic Inn.

The subadult male polar bear had attacked Mutanen on the steps of the Arctic Trading Post and dragged him down a street and back across to the Arctic Inn. It had clasped Mutanen by the head and was shaking him like a rag doll. Here four people came across the bear mauling the man. They surrounded the bear, threw snow on it, rushed it and screamed at it. It charged in response to the agitation. Finally Mike Reimer heard the commotion, grabbed his rifle, ran outside of his apartment and shot the bear.

On 20 November 1983, the Churchill hotel was destroyed by fire leaving remains of food in the kitchen area. Just after midnight on 29 November, Mutanen was rummaging for food in the charred remains. Two kg of raw meat were found in the left front pocket of his parka, pie crust in his right front pocket plus a box of other food he had gathered.

Gordon Stenhouse related this story. Reports of the investigations were also available.

Appendix 4: Records of aggressive polar bear - human interactions kept by agencies contacted during this study

ALASKA

In comparison to the Canadian Arctic, the interaction rate between polar bears and humans is much lower than in the Northwest Territories. This difference results from several factors:

a. Alaskan polar bears are associated primarily with pack ice which recedes from the shoreline every summer. Virtually all denning is offshore and no summer retreats exist anymore. Use of an area by polar bears rarely overlaps with use by people;

b. Oil and gas development is either onshore or much closer to shore than in the Canadian Arctic;

c. Since there are no quotas, any bear that becomes a problem to Inuit is shot;

d. Because the Marine Mammal Protection Act prohibits the export of marine mammal products from the US, there is no market for hides, so little effort is made to find bears and shoot them.

The 1972 Marine Mammal Protection Act transferred the management of polar bears from the state to US Fish and Wildlife Service. This act allows polar bears to be shot for traditional purposes but prohibits the shooting of polar bears in defense of life or property. Native Alaskans have hired themselves out (illegally) as bear monitors to oil exploration camps. The US Fish and Wildlife Service is not prosecuting because their biologists and managers feel the Act is unreasonable by not allowing self defense kills.

Prior to 1972, all records of interactions between polar bears and people should be lodged with the State Department of Public Safety. After 1972, this Department may still have the majority of records since the US Fish and Wildlife has less than six enforcement officers which could investigate a case. However, after the resolution of land claims, the North Slope Borough government was established with its own Department of Public Safety and it should therefore have the most complete set of recent incidents because most Alaskan polar bear habitat is ensconced within its domain. In our search, we could not find any records kept by any Alaskan agency.

Contacts and comments:

Dr. Tom Albert, Public Safety and Environmental Protection Division, North Slope Borough, Barrow. (907) 852-2611 - no records are kept. He has lived there seven years and heard of only a few encounters. He has one of his own and heard of one other involving observers doing bowhead whale counts from shoreline. The bear stuck his head in the tent and was shot. Neither record was used in this study.

Steve Amstrup, Polar bear biologist, US Fish and Wildlife, Anchorage. (907) 786-3424 - he explained the system used to record polar bear - interactions within Alaska and suggested potential sources to contact.

Bob Brown, former State Trooper, Wassila. (907) 269-5751 - private collection of bear (all species) incidents that have occurred in Alaska but he retired last September and could not be contacted because of illness.

Fred Dean, Professer, University of Alaska, Fairbanks. (907) 474-7672 - a lack of funding has prevented preparation of a comprehensive polar bear bibliography. While producing a comprehensive bibliography on black and grizzly bears, he also entered any polar bear references that were collected. As well, he has a bibliography produced by a former student and a US Fish and Wildlife employee (Nick Chura and Jess Low) which was photocopied and sent to both authors.

Glenn Ellison, Director, Arctic National Wildlife Refuge. (907) 456-0250 - they have no records of any polar bear - human interactions.

Erich Follman, Institute of Arctic Biology, University of Alaska, Fairbanks. (907) 474-7338 - when writing his report of carnivore interactions with the construction of the Alaska pipeline, he found no references to problems created by polar bears, even at Prudhoe Bay. He attributed this to the fact that when polar bears come near human settlements (which are primarily native villages or camps), they are shot. Thus they have no chance to get into trouble.

Captain Don Graham, Dewline Coordinator, US Army. Colorado Springs, Colorado. (303) 554-7931 - they keep no records at the dewline sites. They report any interactions to closest wildlife officer, Dept. of Renewable Resources, Govt. of the NWT.

Jeannette McGregor, Public Safety Division, State of Alaska, Juneau, Alaska. (907) 465-4322 - they keep no records of aggressive polar bear - human interactions.

John Middaugh, Head of Epidemiology, State Dept. Public Safety. (907) 561-4406 - they have records of grizzly and black bear interactions with people but none for polar bears.

Scott Schlibe, US Fish and Wildlife Service, Dept. of the Interior, Anchorage, Alaska. (907) 786-3503 - he knew of no agency that kept records of polar bear - human interactions in Alaska. He mentioned one story where a worker at an oil camp shimmied up a pole at the airport when a polar bear approached him. The bear was shot.

Nolan Solomen, head whaling captain, Barter Island. (907) 640-6613 - was not contacted.

YUKON TERRITORIES

Contacts and comments:

Barney Smith, Bear Biologist, Department of Renewable Resources, Govt. of the Yukon, Whitehorse, Yukon Terr. (403) 667-5721 - He knew of no occurrences of aggressive polar bear - human interactions in the Yukon. Polar bears are only seen during winter along the Beaufort coast and sightings are rare.

Ray Frey, Chief Park Warden, North Yukon National Park, Kluane National Park, Haines Junction, Yukon. (403) 634-2251 - was not contacted.

NORTHWEST TERRITORIES

By far the majority of interactions of polar bears with humans occur in the Northwest Territories. There are five potential sources of data:

a. Information about each polar bear that is killed in defense of life or property is recorded on a standard data sheet. Wildlife officers obtain statements from witnesses whenever possible. Approximately two hundred records, dating back to the early 1970's, have been compiled by staff from the Department of Renewable Resources;
b. Records from Auyuittuq National Park on polar bear sightings and interactions with people since 1976;
c. Wildlife Sighting Cards filled out by people reporting to wildlife officers. These are scattered far and wide and were not searched;

d. Sightings of polar bears from oil and gas drilling rigs in the Beaufort Sea; and

e. Narrative accounts of interactions with polar bears from field books of researchers stationed in the Arctic.

Contacts and comments:

Bob Elliot, Chief Warden, Auyuittuq National Park, Pangnirtung, NWT. (819) 473-8962 - he is in the process of writing up the last few years' records of polar bears observed by visitors, park wardens and during denning surveys.

Bob Gamble, Northern Parks Establishment, Parks Canada, Yellowknife, NWT. (403) 873-8477 - information about proposed park reserves in the NWT was received from him.

John Lee, Polar Bear Technician, Dept. Renewable Resources, Govt. of the NWT, Yellowknife, NWT. (403) 873-7782 - gave us access to records of aggressive polar bear - human interactions collected by wildlife officers and also to records of bears captured during population studies.

Ian Stirling, Research Scientist, Canadian Wildlife Service, Edmonton, Alberta. (403) 435-7349 - gave Susan Fleck access to records of aggressive polar bear - human interactions that he has collected or investigated.

MANITOBA

At Churchill, there were no bear problems prior to 1965 because the army was in Churchill and they disposed of any bears that caused problems. People have tried to access the information but it appears to be scanty and hidden in dead files. It was not worthwhile to pursue. After the army left, the bears appeared to increase in number and for 13 or 14 years, polar bears and people were closely associated at the garbage dump and within town. Several injurious attacks in 1966 and 1967 by polar bears caused a review of the situation. The Polar Bear Control Program was initiated. This meant that wildlife officers were stationed at Churchill during the ice-free season to patrol for bears in town, to deter any bears seen or reported, and to kill or remove any bears that could not be deterred or that acted aggressively. That program continues today.

In 1957, York Factory closed down but while it was operating, many females and cubs were killed. A copy of a memo to file compiled by a conservation officer in the mid

1960's who investigated some of the Hudson's Bay Company records of polar bear problems could not be found. There are more records in the Hudson Bay archives in Winnipeg. The killing of bears here may have contributed to lower numbers of bears around Churchill than there are now.

Contacts and comments:

Shelley Billenduke, Acting Superintendent, Parks Canada, Churchill, Manitoba. (204) 675-8863 - she was interviewed by Steven Herrero for information on visitor use and the detection and deterrent program used at the Churchill and York Factory National Historic Park and Sites.

Steve Kearney, Management Biologist, Dept. of Natural Resources, Thompson, Manitoba. (204) 778-4411 - has the most complete records of aggressive polar bear - human interactions that have occurred in Manitoba. Churchill records are rather scattered because of the many changes in personnel that have occurred since 1976 when a conservation officer was first put there.

At Thompson they have records of all bear "occurrences," meaning anytime a bear approached within 1 km of a human habitation and was noticed. There are probably several hundred of these. These are summarized within the Polar Bear Control Program Annual Report. The incidents which resulted in a dead bear or injury have much more detail on them than the occurrence reports.

Merlin Shoesmith, Director, Wildlife Research, Dept. of Natural Resources, Winnipeg. (204) 945-6809 - directed Susan Fleck to appropriate contacts.

Ian Thorliefson, formerly with Department of Natural Resources, Thompson, Man. (204) 778-4411 - explained the past history of polar bear problems at Churchill. This is also documented in Stirling et al. (1977).

Paul Watts, Institute of Arctic Ecophysiology, Churchill, Manitoba. (204) 675-2131 - conducted interviews of people who had aggressive interactions with polar bears.

ONTARIO

No interactions with polar bears that resulted in human injury have been reported, partially because polar bear concentrations and human habitation rarely overlap along the Ontario Hudson Bay coastline. Interactions do occur occasionally at fishing and goose camps. Fourteen outfitters were contacted by letter. We received only two responses. Bears that interact with natives are usually shot and claimed under Ontario's quota of 30 bears.

Contacts:

Ken Abraham, Officer, Ontario Ministry of Natural Resources, Moosonee. (705) 336-2987 - he discussed the lack of incidents because of bear and human ecology differences. He sent a list of outfitters to contact to obtain some narrative accounts.

Douglas Alexander, Norcan Travel, Thunder Bay, Ontario. (807) 623-4633 - no shots were fired during two interactions that their clients had with polar bears at Shagamu River Goose Camp. However, the family living at Shagamu has had to shoot more than one problem polar bear. Cree guides with rifles accompany all clients.

R.W. Brooks, Tourism Development Office, Ontario Northland Transportation Commission, North Bay. (705) 472-4500 - no problems with polar bears in their goose camp.

George Kolenosky, Biologist, Ontario Ministry of Natural Resources, Maple. (416) 832-2761 - he explained that no system to record bears that are killed in defence of life or property exists.

George O'Reilly, Information Officer, Ministry Natural Resources, Cochrane. (705) 272-7027 - did initial surveys of Polar Bear Provincial Park in James Bay and should have ecological information on polar bears in that area. He was not contacted.

QUEBEC

Contact and comments:

Dr. Michel Crete, Direction de la Recherche Faunique, Quebec City. (418) 643-1791 - during winter, polar bears are on the sea ice and cause no problems. They spend the ice-free season on small islands and do not interact with people. No aggressive interactions have occurred in Quebec and and no system exists to record any should they occur.

LABRADOR

Contact and comments:

Stu Luttich, Biologist, Labrador Wildlife Division, Goose Bay. (709) 896-2732 - there are few polar bears along

Labrador. There is the occasional aggressive interaction in summer fish camps on the outer islands but no humans have been injured. People either shoot the bear or leave themselves.

GREENLAND

Contacts and comments:

Dr. Poul Henrichsen, Zool. Museum, Universitatsparken 15, DK-2100, Copenhagen, Denmark - he has published a paper in Danish on polar bear/human encounters that have occurred in Greenland, however, it was unavailable.

Dr. Erik Born, Gronlands Fiskari und Miljoundersogelser, Tagensvej-135, 1.sal, DK-2200, Copenhagen N, Denmark. (01) 85 44 44 - neither they nor any other Danish or Greenlandic agency maintain records in Greenland. He believes that injurious interactions between polar bears and humans in Greenland are rare.

NORWAY

Contacts and comments:

Ian Gjertz, Wildlife Management Officer, Sysselmannen pa Svalbard, 9170 Longyearbyen, Norway - detailed records of interactions between polar bears and humans are not kept by any Norwegian agency, however, they did send a record of the number and location of polar bears shot in self defense in Svalbard, and a summary of seasonal polar bear distribution and conflicts. Unfortunately, no other descriptive data about the interactions were included and so we did not use this information in our analysis.

Thor Larsen, Norsk Polar Institutt 1, Valkyriegaten 17, 0366 Oslo 3, Norway. (02) 69 61 63 - he was on sabbatical in Africa and was not contacted. Since then, he has left the Norst Polar Institut.

FINLAND

Contact and comment:

Dr. Eric S. Nyholm, Finnish Game Research Institute, Predator Research, Katekeetantie 3 E 4, 93600 Kuusamo, Finland - he described one fatal polar bear - human interaction and discussed characteristics of polar bear behaviour with Steven Herrero.

RUSSIA

Contacts and comments:

Dr. Savva Uspenski, Chief, Arctic Ecosystem Division, Head of Laboratory, Institut Nature Conservation, Moscow, USSR. - He intends to send a copy of his article "Polar Bear and the Man" when it is published in the Soviet magazine "Hunting and Hunt Management".

Dr. S.E. Belikov, Central Laboratory of Nature Conservation, USSR Ministry of Agriculture, 113628 Moscow, USSR - he is presently analyzing records of interactions between polar bears and people that he collected on his last Arctic expedition.

Appendix 5. Data that should be recorded when investigating a polar bear - human interaction

During the analysis of the data, we realized that a number of data gaps existed. There were primarily three reasons why these data gaps occurred:

1. certain types of information were not always recorded (e.g. sex or age of polar bear);
2. few incidents have occurred (e.g. injurious polar bear - human interactions); and
3. few incidents have been recorded (e.g. non-injurious polar bear - human interactions in which the bear was not killed or injured).

Therefore, we have prepared the following list of the types of information that should be included when investigating a polar bear - human interaction. If these data are consistently recorded then future analysis should improve our understanding of why polar bear - human interactions occur and how to prevent them.

1. Data on polar bear should include:
    - a. sex;
    - b. age;
    - c. condition;
    - d. the number of bears involved;
    - e. the relationship among the bears (e.g. female with cubs, sibling pair, etc.);
    - f. initial behaviour of the bear. Behaviour of the bear should include observations on vocalization, body position, speed of approach, change in mood, and activity;
    - g. behaviour of the bear during the interaction;
    - h. distance at which bear was first observed;
    - i. closest approach of bear;
    - j. prior history of bear (e.g. captured, problem, etc.); and
    - k. how interaction ends (e.g. bear is shot, bear is injured and leaves, etc.).

2. Data on site and location should include:
    - a. geographic location (e.g. latitude and longitude);
    - b. site type (e.g. hunting camp, exploration site, settlement, etc.);
    - c. habitat
    - d. type of attractants present;
    - e. date of interaction;
    - f. time of day; and
    - g. duration of interaction.

3. Data on humans involved should include:
    a. name of person;
    b. sex;
    c. age;
    d. ethnic origin;
    e. behaviour immediately prior to onset of interaction;
    f. behaviour during interaction;
    g. injurious or non-injurious interaction;
    h. perceived motive of bear;
    i. reason for killing bear;
    j. name of person recording information on interaction;
    k. group size;
    l. availability of firearms;
    m. firearms experience of person(s);
    n. property damage; and
    o. experience of person(s) with polar bears.

4. Data on detection and deterrents should include:
    a. use of detection devices;
    b. type of deterrents available and deployed;
    c. experience of person in deploying deterrents;
    d. distance at which deterrents tried; and
    e. reaction of bear to deterrents.

5. If person is injured or killed, data should include:
    a. injury or death;
    b. location of injuries;
    c. length of hospitalization;
    d. if person tried to defend themselves against the bear; and
    e. whether part of the victim was consumed by the bear.